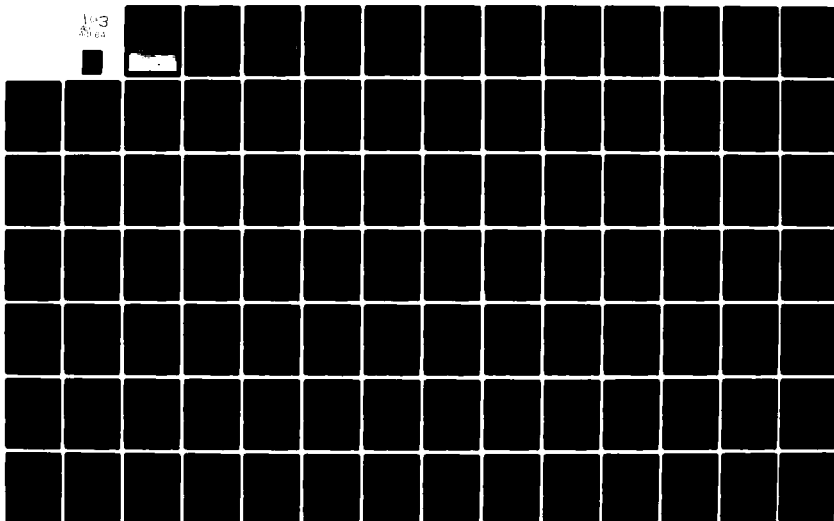


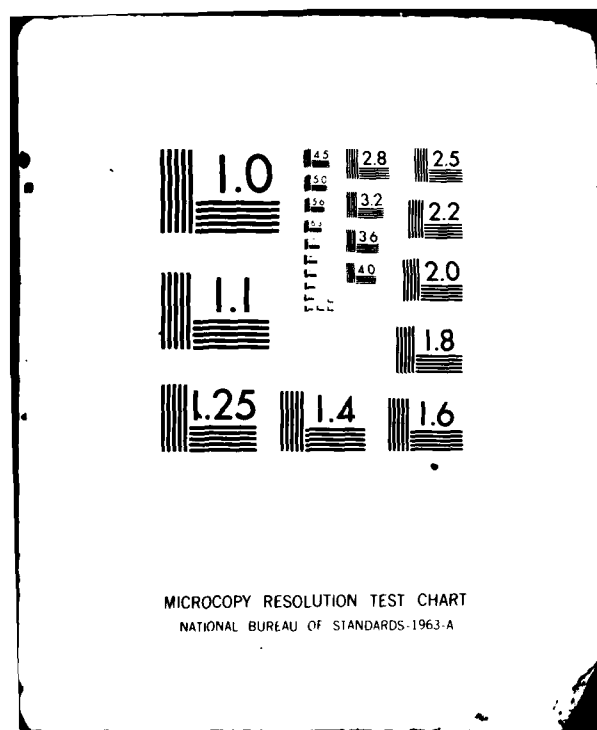
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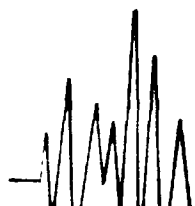
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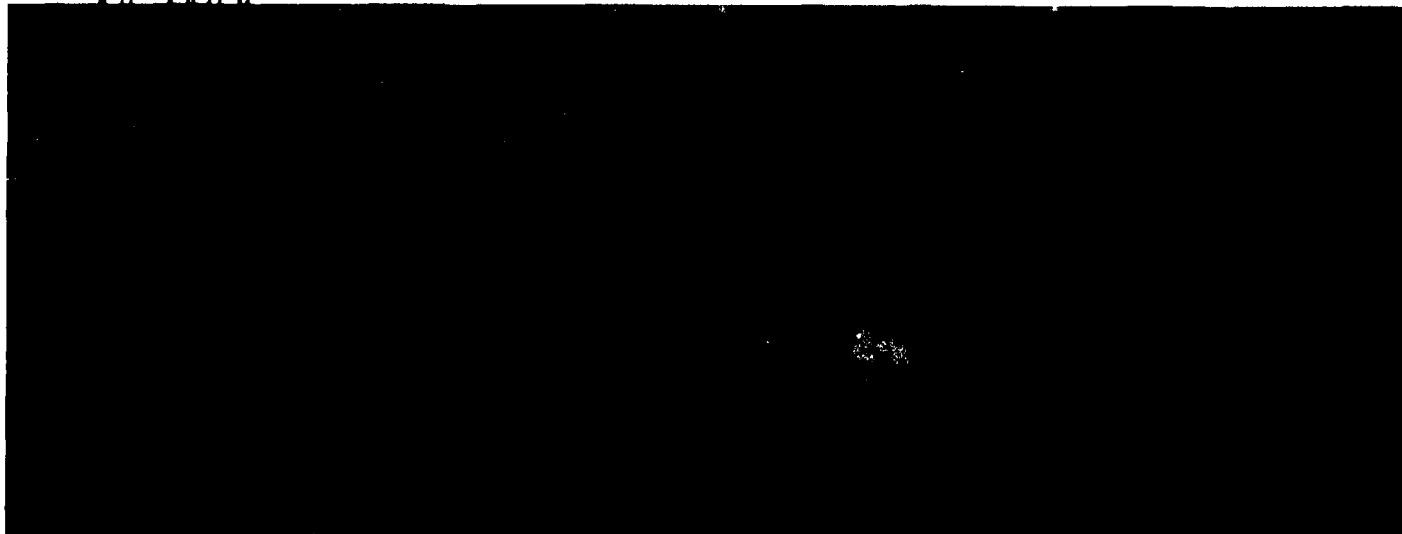
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ABSTRACT

This report presents the final results of work performed by ARINC Research Corporation under Contract F09603-80-G-3338-0011 with Warner Robins Air Logistics Center/MMRRAH. ARINC Research was tasked to perform a long-range study of the functional and system requirements of the Electronic Warfare Avionics Integration Support Facility (EWAISF) support processor. This document describes the results of the four phases of that effort: the definition of functional requirements, specification of requirements for automatic data processing equipment (ADPE) and software, identification of alternative architectures to fulfill these requirements, and a cost-benefit analysis of the alternatives. In addition, it presents recommendations for implementing a preferred architecture and describes a means for updating the study in the event that requirements or operational constraints should change.

CONTENTS

	<u>Page</u>
ABSTRACT	v
CHAPTER ONE: BACKGROUND	1-1
CHAPTER TWO: PROJECT OBJECTIVES	2-1
CHAPTER THREE: PROJECT APPROACH	3-1
3.1 Overview	3-1
3.2 Phase 1 - Functional Analysis	3-2
3.3 Phase 2 - Requirements Analysis	3-4
3.3.1 Definition Leveling	3-4
3.3.2 Setting Requirements Priorities	3-4
3.3.3 Requirements Validation	3-4
3.4 Phase 3 - Alternatives Definition	3-5
3.5 Phase 4 - Cost-Benefit Analysis	3-5
CHAPTER FOUR: EWAISF SUPPORT REQUIREMENTS	4-1
4.1 Functional Analysis Results	4-1
4.1.1 Application Requirements	4-1
4.1.2 Support Processor Requirements	4-8
4.2 Requirements Analysis Results	4-9
4.2.1 Composite Requirements	4-10
4.2.2 Setting Requirements Priorities	4-10
4.2.3 Requirements Validation	4-10
4.2.4 ADPE and Software Requirements	4-19
CHAPTER FIVE: ALTERNATIVE SUPPORT ARCHITECTURES	5-1
5.1 Single-Processor Architecture	5-2
5.1.1 Concept	5-2
5.1.2 System Components	5-3
5.2 Multiple-Processor Architecture	5-6
5.2.1 Concept	5-6
5.2.2 System Components	5-8

CONTENTS (continued)

	<u>Page</u>
5.3 Front-End Processor Architecture	5-9
5.3.1 Concept	5-9
5.3.2 System Components	5-10
5.4 Summary	5-13
 CHAPTER SIX: COST-BENEFIT ANALYSIS	 6-1
6.1 Methodology	6-1
6.2 Architectural Alternatives	6-1
6.3 Cost Estimation	6-2
6.3.1 Development	6-4
6.3.2 Investment	6-4
6.3.3 Operation	6-5
6.3.4 Composite Life-Cycle-Cost Estimates	6-7
6.4 Benefits Estimation	6-7
6.4.1 System Performance as System Benefit	6-7
6.4.2 Strategy for Estimating Performance	6-7
6.4.3 Comparative Simulation Results	6-14
 CHAPTER SEVEN: RECOMMENDATIONS FOR IMPLEMENTING THE PREFERRED ALTERNATIVE	 7-1
7.1 Overview of Approach	7-1
7.1.1 Phase 1: Multiple-Processor Prototype Development	7-1
7.1.2 Phase 2: Initial Operation	7-4
7.1.3 Phase 3: Front-End Processor Prototype Development	7-4
7.1.4 Phase 4: Front-End Processor Operation	7-5
7.2 Schedule	7-5
7.3 Other Considerations	7-7
 APPENDIX A: USER REQUIREMENTS DEFINITION	 A-1
APPENDIX B: COMPOSITE FUNCTIONAL REQUIREMENTS	B-1
APPENDIX C: FINANCIAL BASIS FOR COST ESTIMATES	C-1

CONTENTS (continued)

	<u>Page</u>
APPENDIX D: PRICE QUOTATIONS	D-1
APPENDIX E: PERFORMANCE SIMULATION	E-1
APPENDIX F: STUDY UPDATE PROCEDURE	F-1

CHAPTER ONE

BACKGROUND

In 1975, the Engineering Division (MME) developed a data automation requirement (DAR) for an Electronic Warfare Avionics Integration Support Facility (EWAISF) host computing capability. The DAR was developed in response to a need for a host computing facility to provide management and computational support to MME. In September 1976, two excess computer systems became available, an IBM 360/65 and a UNIVAC 1108. An evaluation was performed; the UNIVAC 1108 was selected; and, in February 1977, the excess equipment was delivered to Robins Air Force Base (AFB) from the Global Weather Center (AFGWC), Offutt AFB, Nebraska. It was anticipated early that the processing requirement for the U1108 would grow.

The need for "continuous acquisition planning" was recognized in the *EWAISF Host Computer Data Project Plan (DPP)*, dated 10 March 1977. That plan documented the initial acquisition planning for the host computer facility. Since the development of the DPP, the anticipated workload for the U1108 has increased due to the expansion of the U1108 user base as well as to an expansion of the functions to be performed. The functions currently supported by the host computing facility were documented in the *Concept of Operation, EWAISF Host Processor, UNIVAC 1108*, dated 19 September 1980. This is a working document that evolves to reflect changes in requirements and plans. Utilization of the EWAISF support processor is a direct function of the number of users and of the electronic warfare and operational flight programs (EW/OFP) supported. Recent growth in U1108 workload and anticipated expansion of processor functions and systems supported have prompted the current system manager (MMRRAH) to initiate this study to define support processor requirements for 1985 and beyond.

CHAPTER TWO

PROJECT OBJECTIVES

ARINC Research Corporation is under contract with Warner Robins ALC/MMRRAH to define the EWASIF support processor requirements for 1985 and beyond and develop recommendations for satisfying those requirements. The output of this effort should provide the Air Force with adequate background information for preparation of an acquisition justification for any automatic data processing equipment (ADPE) or software required by the EWASIF in that time frame. The specific tasks required to accomplish these objectives are (1) definition of support processor functional requirements, (2) synthesis of ADPE and software requirements, (3) development of alternative approaches, (4) economic analysis of alternatives, and (5) selection and documentation of a preferred alternative. An additional objective to be achieved from this effort is a method that will allow MMRRAH to update the study results as required by unforeseen changes in EWASIF support processor requirements.

CHAPTER THREE

PROJECT APPROACH

3.1 OVERVIEW

The technical approach consisted of an orderly, disciplined procedure of four steps:

- Defining EWAISF support processor functional requirements
- Quantifying system performance criteria
- Projecting system growth
- Selecting the most cost-effective approach to satisfying the system requirements

The philosophy underlying the approach called for continuous user participation. Each phase of the effort was directly linked to the other phases, ensuring that system requirements were complete and correct and that the recommended alternative satisfied the requirements in a cost-effective and affordable manner. The effort consisted of four phases:

1. Functional Analysis - Review of previous efforts, definition of EWAISF support processor functions, and development of preliminary supporting data requirements
2. Requirements Analysis - Development of automatic data processing performance requirements and setting priorities and selecting functional requirements for implementation
3. Alternatives Definition - Development of alternative approaches, ADP configurations, software, and procedures to satisfy the requirements as defined in the requirements analysis phase
4. Cost-Benefit Analysis - Analysis of the benefits (quantifiable and nonquantifiable) to be derived from each of the alternatives, and estimation of the life-cycle costs of each alternative

This document presents the final results of the efforts under each of the four phases and the recommended approach for implementing the preferred alternative.

3.2 PHASE 1 - FUNCTIONAL ANALYSIS

The purpose of this task was to define the long-range functional requirements for an EWAISF support processor. The objective was to develop a baseline set of functions to which performance criteria can be attached and against which alternative solutions can be hypothesized. This analysis consisted of four activities:

- Review of current definitions of requirements
- Review of previous analyses
- Interviews of users
- Definition of functional requirements

The current definitions of requirements are contained in the Concept of Operations and in initial surveys previously conducted by MMR personnel. These sources were reviewed to familiarize the study team with the EWAISF support processor applications environment. In addition, projected requirements were summarized for some electronic warfare (EW) systems in their resource acquisition management plans (RAMPs). Those RAMPs available at the time of the first phase were reviewed for background data. Two previous analyses were reviewed in preparation for the first phase. The first presented requirements for a project control and monitoring system* and the second described the results of a previous support software study.**

A preliminary survey of current and potential support processor users was conducted to solicit projected functional requirements. These users included EW systems engineering and logistics management personnel, administrative and MMR division support personnel, and MMEC personnel providing operational flight program engineering or logistics management. The requirements identified in the preliminary surveys were recorded on requirement specification forms, Figure 3-1. The user-defined requirements were then categorized and summarized for presentation herein. The forms will provide an audit trail for each identified requirement throughout the study.

The specification forms show the requirements anticipated by support processor users for 1985 and beyond. Some of these requirements are currently supported by the UNIVAC U1108 system, but others are not. For some, the support requirements change from the present to the study time frame. The form is divided into three general fields: descriptive information, current ADP support, and projected requirements for 1985 and beyond.

*Interim Engineering Report, System Requirements for Project Monitoring and Control System, TM-HU-400/000/00, System Development Corporation, August 24, 1976.

**Electronic Warfare Avionics Integration Support Facility Support Software Study - Final Report, TRW Defense and Space Systems Group, December 1977.

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function:	System:	Projected Life:	User/Contact:
Description of Function:		Frequency of Function:	
Current Support		Projected Requirements	
ADPE Resources	Software Functions	ADPE Resources	Software Functions
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

Figure 3-1. SAMPLE ADP REQUIREMENTS SPECIFICATIONS FORM

The information necessary for this phase of the analysis consisted of the descriptive information to be provided in the upper portion of the form and the software functions portions of the current support and projected requirements sections. Any additional information supplied by the respondents was included; if there was none, the areas not required were left blank. The forms, as completed and reviewed by the users, are included in the appendix of this report. The basis or definition of responses varied from user to user. No attempt was made to level these definitions in Phase 1, but this was accomplished in the iterative interview portion of the requirements analysis phase.

3.3 PHASE 2 - REQUIREMENTS ANALYSIS

The first phase, Functional Analysis, elicited and summarized the functional requirements of the EWAISF support processor from the viewpoint of the individual users and applications. The second phase, Requirements Analysis, provided a leveling of the definitions of the requirements, set priorities among the requirements by the users, and provided a validation of the requirements by EWAISF management personnel.

3.3.1 Definition Leveling

The first task in Phase 2 was to develop a composite set of definitions for the requirements identified in Phase 1. To accomplish this task, the complete set of Requirements Specification Forms developed in Phase 1 was circulated to the users for review. This allowed them to review their own requirements and, in addition, provided them the opportunity to review those of other users. The review stimulated additional requirements and led to the refinement of those under review. At the completion of the review, the responses were collected and applied to the identified requirements to develop a composite, consensus list of functional requirements for validation.

3.3.2 Setting Requirements Priorities

Following the leveling process, the composite requirements definitions were circulated to the users for a final review. At this time, the users were requested to rank the requirements in order of their operational priorities. Mean and standard deviations of the priorities were then calculated.

3.3.3 Requirements Validation

After the priority survey was completed, the user requirements were presented to EWAISF management personnel for validation. The requirements were first presented to the Integrated Support Station (ISS) Support Subcommittee. The Subcommittee reviewed the requirements are presented recommendations to the EWAISF Committee, which validated a set of functional requirements. This set of requirements provides the basis for the remaining phases of this study.

3.4 PHASE 3 - ALTERNATIVES DEFINITION

The third phase of the study, Alternatives Definition, provides a description of alternative architectures for fulfilling the ADPE and software requirements specified as a result of Phase 2, Requirements Analysis. From an initial set of candidate architectures, three were selected for further evaluation in Phase 4, Cost-Benefit Analysis. Low- and high-cost options were specified for each alternative, corresponding to inclusion of the required capabilities (low cost) or the required and desired capabilities (high cost), as identified in Phase 2.

Three architectures were presented to the ISS Support Subcommittee at its regularly scheduled June meeting. One of the architectures was replaced with another considered to be of less technical risk. The computer vendor community was then surveyed to assure that the three candidate architectures could be implemented with current, commercially available ADPE and support software. The resultant candidate architectures are described in Chapter Five.

3.5 PHASE 4 - COST-BENEFIT ANALYSIS

The fourth phase of this effort, Cost-Benefit Analysis, yields an assessment of the relative cost-effectiveness of the alternatives defined in Phase 3. The cost estimation of the alternatives was relatively straightforward. The cost model used in the study was formulated and presented to the ISS Support Subcommittee for approval. Cost data were then collected and summarized for the 10-year system life cycle.

The benefits estimation was more complex. Three separate approaches were developed: qualitative assessment, panel scoring, and performance simulation. These alternatives were presented to the ISS Support Subcommittee, which selected performance simulation as the technique to be employed.

The results of the cost and benefits estimations were then summarized and are presented in Chapter Six.

CHAPTER FOUR

EWALSF SUPPORT REQUIREMENTS

This chapter presents the results of an examination of the EWALSF support processor long-range requirements through the first two phases -- Functional Analysis and Requirements Analysis.

4.1 FUNCTIONAL ANALYSIS RESULTS

The results of Phase 1, Functional Analysis, are presented in two categories: applications requirements and support processor requirements. Applications requirements are those identified by EWALSF support processor users as either required or desired capabilities in the time frame to which the study applies, 1985 and beyond. This does not imply that some of the capabilities are not currently required, only that they will be required in 1985 and after. The requirements definitions, as presented in the appendix, were reviewed with the originators, where possible, to ensure their accuracy. They are summarized herein.

The support processor requirements are those implicit ones derived from the requirements specified by the users. They are generally functions required to satisfy a particular operational consideration or mode, e.g., interactive inquiry or remote printer control. Those presented herein represent only those derived from the applications requirements or identified by interviewees. Other support processing requirements will evolve with the development of alternative system architectures and specific operating modes during subsequent study phases.

4.1.1 Application Requirements

The application requirements specified by the survey population fall into four broad categories:

- System operational software support
- Engineering management support
- Logistics management support
- Administrative and division management support

System operational software support includes those capabilities required to support the electronic warfare (EW), avionics operational flight program (OFP), or emitter identification data (EID) software changes, including code modification, testing, and change distribution. Engineering management support includes those capabilities required to plan, monitor, and implement OFP, EID, and support software or hardware changes. Logistics management support includes capabilities for planning, budgeting, implementing, and monitoring integrated logistics support elements for EW systems. Administrative and division management support functions are those necessary to plan and control division resources in the accomplishment of the other functions. Each of these categories is summarized below.

4.1.1.1 System Operational Software Support

The system operational software support requirements identified by the interviewees were subdivided into the following classes:

- Code development
- Verification and validation (V&V) and test
- Documentation maintenance
- Change distribution

A general consensus existed among systems engineers that change software development support by an EWAISF support processor should consist of providing interactive back-up capabilities to the system ISSs or avionics integrated support facilities (AISFs). The specific functions described included program file maintenance, code creation and editing, program assembly and binding, and loading of software to system processors. The processors for which these capabilities would be required are listed in Table 4-1. Program file maintenance was defined to be a means of transferring software changes from the ISS edit/assembly station to the EWAISF support processor to maintain currency of the back-up files. Code development was defined to consist of source file editing facilities. Assembly and binding refers to the process of preparing executable programs from assembler-level source code. Loading of software to system processors varied somewhat in definition from preparation of binary tapes to direct download over a data link. No requirements for compilation of higher order language (HOL) source programs were explicitly identified. However, certain identified requirements create an implicit requirement for compilation of HOLs.

A wide range of capabilities was identified as being required to support verification and validation and system test. No general consensus was developed for any specific capability. Table 4-2 is a matrix relating the capabilities identified and the offices or systems specifying the requirements. The categories are fairly broad, but for the purposes of this analysis have these general definitions:

- ECP Traceability. This is the capability to track engineering change proposal (ECP) requirements from specification to implementation and to monitor V&V and test results on the basis of individual requirements.

Table 4-1. SYSTEM PROCESSORS TO BE SUPPORTED	
System	Processor
EF-111 TJS	IBM 4Pi Litton LC-4516 AN/AYK-14* Teledyne*
AN/ALR-62	CM 456
AN/ALQ-119	CX2-475-01 Intel 8085 Zilog 280
AN/ALQ-69	CM 479 ATAC-8
AN/ALR-69 (Update)	ATAC-16M
AN/ALQ-131	Westinghouse Millicomputer
F-15 TEWS	TI 2520-2 Motorola 6800
AN/ALQ-155	Intel 3001 (emulating NOVA)
AN/ALR-46	CM 442, 442A
AN/APR-38	TI 1255
AN/ALQ-125	LC 4516
AN/ALM-126	HP9825
AN/ALQ-165	ATAC-16M
IRS	Intel 8085
FLTS	Not Determined
AN/ALQ-117	ITT Microprocessors
*Potential requirement, not firm at this point.	

- Data Reduction/Analysis. This includes rehosting of existing software packages and provision of generalized data sorting and statistical analysis routines. This area provided the least detailed requirement definition of the analysis, yet was one of the more widely requested capabilities. This may have been so because a number of systems are just making a transition or will in the near future, and only two or three systems [including F-15 Tactical Electronic Warfare System (TEWS) and APR-38] have any significant experience in this area.

Table 4-2. VERIFICATION AND VALIDATION AND TEST REQUIREMENTS					
System or Organization	Capability				
	ECP Traceability	Data Reduction/Analysis	Emulation/Simulation/Modeling	Threat Data Base Maintenance and Extraction	Performance Software Analysis
AN/ALR-62	X	X			
AN/ALQ-119		X			
AN/ALR-46		X			
AN/ALR-69 (Update)			X		
F-15 TEWS		X	X		
EWOLS/ECSAS				X	
AN/ALQ-155					X
AN/APR-38		X			
QM-1 (MMEC V&V)			X		X
AMRAAM			X		
Software Tools				X	X
Host Processor (U1108)			X		X

- Emulation/Simulation/Modeling. Emulation requirements were defined for specific processors and as generalized emulation capabilities. Simulation and modeling were divided into two subclasses, on-line environmental simulations and off-line system and software simulations.
- Threat Data Maintenance/Extraction. This is the ability to maintain the electronic warfare integrated reprogramming data base and provide target parameters for threat simulator operations.
- Performance/Software Analysis. This is the capability to analyze software statically for syntactic correctness or code optimization and to dynamically collect execution data to determine subroutine use and choke points.

Documentation maintenance was consistently identified as a necessary capability, independent of the system ISSs. Two types of documentation support were identified. The first is document production support, consisting of text entry and editing capabilities, page and document formatting, and document printing. These are typical word processing capabilities. The second type of documentation support identified is the automatic production of computer software documentation. This typically consists of memory/load maps, cross-reference lists, flow charts and module hierarchies, and interface listings.

Distribution of OFP and EID changes from field reprogramming has generally been accomplished by mailing the changes on paper tape. Most systems now require the use of AUTODIN for change transmissions, particularly for emergency changes. Therefore, an EWASIF support processor should be capable of producing AUTODIN-compatible binary magnetic tape for message transmission. These tapes must also be compatible with whatever memory loader/verifier capability exists in the field.

4.1.1.2 Engineering Management Support

A number of capabilities identified fall into the category of support to the management of the change process. These include the following:

- Document control
- Project planning and control
- Configuration management
- Software archive support

Document control provides for the status accounting and location of all system-related documentation. This was identified as two types of requirement -- documentation identification and location tracking, and documentation effectivity and traceability. Those systems or organizations requesting these functions are shown in Table 4-3.

The requirements for project planning and control involved a fairly wide range of capability. The defined capabilities range from simple

Table 4-3. DOCUMENT CONTROL REQUIREMENTS		
System or Organization	Documentation Identification and Location	Document Effectivity/Traceability
AN/ALR-62	X	X
AN/ALQ-119	X	
EWOLS/ECSAS	X	X
AN/ALR-46	X	
AN/ALR-69	X	
AN/ALQ-131	X	
EF-111A	X	
F-15 TEWS		X
AN/ALQ-155	X	
AN/APR-38	X	
AN/APR-125	X	
GPS	X	
Software Tools Group		X

tabular or printer graphics display of milestone schedules to network analysis of schedule dependencies and graphic output of milestone schedules. The types of requirements identified, by originator, are shown in Table 4-4.

Configuration management consisted of a capability to track ECP status from origination through Configuration Control Board approval and to provide configuration status accounting and audit support.

Finally, three respondents identified the need for a permanent program support library or software archive. Such a capability would provide for (1) a software back-up for catastrophic failure and (2) a centralized source of software routines (common and unique), test scenarios/data, and documentation.

4.1.1.3 Logistics Management Support

Due to the constraints of the Phase 1 interview schedule, the logistics management personnel were not interviewed as extensively as were the engineering personnel. However, applicable requirements documentation has been obtained from the Management Information System Steering Committee. This

Table 4-4. PROJECT PLANNING AND CONTROL REQUIREMENTS				
System or Organization	Milestone Charting	Schedule Tracking	Resource Tracking	Network Analysis
AN/ALQ-119	X	X		
EWOLS/ECSAS	X	X	X	X
AN/ALR-46		X	X	X
AN/ALR-69 (Update)	X	X	X	X
AN/ALQ-131		X	X	X
EF-111A	X	X	X	
AN/ALQ-155	X	X	X	
AN/APR-38	X	X		
MMEC		X	X	
GPS		X	X	
MMRRW		X	X	X
MMRRAH		X	X	X

material has been reviewed and included for the Phase 2 analysis. The following main areas were identified in this documentation:

- Program scheduling
- Production planning
- ECP tracking
- CDRL monitoring
- Budget projection

These requirements have been investigated in Phase 2 and, where appropriate, integrated with the Phase 1 interview results.

The requirements identified to date are oriented to program planning and tracking, resource planning and tracking, and budget preparation and monitoring; they include the following:

- Program scheduling and milestone tracking
- Resource allocation and tracking
- Program action audit
- Program documentation storage and recall
- Contract data requirements list preparation

- Parts reference automation
- GFE accountability
- Budget analysis and preparation
- Budget "checkbook" maintenance

4.1.1.4 Administrative and Division Management Support

Administrative and management support requirements fall into two broad classes -- control requirements and information requirements. The management information requirements of the Electronic Warfare Management Division (MMR) are the subject of a current study by an MMR Management Information System Steering Committee. They were not addressed in Phase 1.

A number of management and administrative control requirements were identified in Phase 1. These included the following:

- Document control (identification and location)
- Division cost accounting and projection
- Budget monitoring
- Automated mail distribution
- Suspense control
- Change process management

Document control includes logging, cataloging, and tracking of documents received or generated by MMR. Cost accounting and projection refers to development of a division cost accrual system capable of accumulating expenditures of manpower, facilities, consumables, and other resources by individual, organization, project, or foreign military sales case. This capability would then provide development of cost planning factors for budget projection. Budget monitoring would provide management with budget status by organization, system, type, or source of funds. Automated mail distribution and suspense control would provide distribution of internal mail by cathode ray tube (CRT); establishment and notification of milestones, suspense dates, and items; reporting thresholds; and monitoring responses. Change process management would provide ECP identification and distribution, status reporting, approval control, and configuration control board agenda development. This capability would logically require the suspense control capability previously identified.

4.1.2 Support Processor Requirements

Functional requirements of a support processor fall into four areas -- support software development tools, software test tools, architecturally implied control functions, and support processor management functions. For the most part, support software development tools have been written in

FORTTRAN IV. This requirement to support FORTRAN IV will continue in the near future. It is possible that increased language compilation and debug capabilities may be required from 1985 on. Potential candidates for this support are Ada, JOVIAL J(73), Pascal, COBOL, FORTH, CMS-2, and FORTRAN IV. In addition to requiring compilers, support software will impose many of the same requirements as operational software, e.g., text editing, threat data base support, V&V tool support, documentation support, and code analysis and optimization. Software test tools encompassed a variety of functions including code analysis (syntax), dynamic analysis (performance), and test data generators.

Another area of support processor requirements is control functions. These functions are those which provide for the orderly implementation of a support processor architecture. The specific functions are architecture-dependent; therefore, they will be addressed in Phase 3 - Alternative Development. However, five general classes of functions are to be considered:

- Operating systems service
- Interactive terminal service
- Processor networking support
- Peripheral/processor interface
- Security access control

The third class of support processor functional requirements -- management functions -- is somewhat independent of architecture. These requirements were identified in the Phase 1 interviews:

- Applications requirement development tracking
- Configuration status accounting
- System performance management
- Cost accounting

Many of these functions are analogous to those defined for the EW and avionics systems, e.g., requirement tracking and configuration management. Others, such as cost accounting for usage and performance measurement and on-line monitoring, are in some ways unique to the operation of large-scale support processors. Details of those capabilities identified to date are included in the appendix.

4.2 REQUIREMENTS ANALYSIS RESULTS

Phase 2 of this study, Requirements Analysis, consisted of developing a composite, consensus list of user functional requirements, setting priorities among the requirements, and validating a set of requirements for the 1985-and-beyond EWAISF support processor. The composite requirements were

developed by iteratively circulating the functional requirements identified in Phase 1 to the users for comment, coalescing the comments into composite requirements descriptions, and submitting them to the users for final review. The priorities of requirements were developed by requesting the users to rank the priorities in order of the user's need for the function. Finally, EWAISF management personnel reviewed the composite requirements and validated a set of functions to be pursued in subsequent study phases.

4.2.1 Composite Requirements

The functional requirements identified in Phase 1 were presented to the users in the following categories:

- Software change support
- Other engineering support
- Division management support
- Logistics management support

Users' comments were consolidated and composite descriptions derived. These were submitted to the users in the above categories, and final comments were incorporated. As a result of the functional requirements identified, a fifth category, Implied Functions, was developed. The resulting composite requirements, for which priorities were subsequently set and which were presented for validation, are presented in Table 4-5.

4.2.2 Setting Requirements Priorities

Concurrent with the final review of requirements definitions, the users were requested to rank the composite requirements in order of the basis of need or desirability. Approximately 50 percent of the users responded. The results are shown in Table 4-6. The term \bar{x} indicates the mean ranking for the requirement, while the term σ_n indicates the standard deviation of the ranking. Within the functional areas, rankings were very consistent, i.e., engineering personnel ranked requirements similarly, as did logistics management personnel and MMEC personnel.

4.2.3 Requirements Validation

The functional requirements and their priorities were presented to EWAISF management personnel in two separate presentations. The first presentation was made to the ISS Support Subcommittee on 8 April 1981. At that meeting the subcommittee divided the requirements into three categories: required, desired, and not recommended. Those items not recommended included Program History, Logistics Support Data Base, GFE Accountability, Repair Restrictions Data Base, Checkbook, Suspense Tracking, and Automated Mail System.

The requirements presentation was repeated to the EWAISF Committee, along with the recommendations of the ISS Support Subcommittee. The EWAISF Committee accepted the basic recommendations of the subcommittee, but

Table 4-5. COMPOSITE REQUIREMENTS

Requirement	Description
Software Change Support	
Text/File Edit	Provide capability to enter, edit, duplicate, purge, and store programs, data, and text files in character format. The capability should provide for maintenance of variable-length records.
Cross Compilation/Assembly	Provide cross compilation and assembly of programs for target processors.
Automatic Software Documentation	Provide capability to generate software documentation automatically, i.e., memory maps, subroutine interface listings, and flow charts.
Threat Data Base Maintenance	Provide maintenance of the EWIR or other threat data bases and extract, sort, and format threat data for use by other systems.
Data Reduction/Analysis	Allow input of data from ISS or flight test (including pod-recorded data) and provide generalized correlation and report formatting capabilities.
V&V Test Support	Provide software test tools to support software V&V. These may be generalized or specific to a target processor and include test data generators and smart editors.
V&V Tracking	Provide change traceability for test tracking purposes.
Emulation	Provide a generalized capability to emulate other processors for software debug.
Change Distribution	Provide an automated medium for distribution of software changes to the field.
Data Table Generation	Provide the capability to output data table messages for field updates.

(continued)

Table 4-5. (continued)	
Requirement	Description
Software Change Support (continued)	
On-Line Simulation	Provide for on-line digital environment simulation (1) to provide operating environment for processor emulations or (2) to provide a test environment in the event RF test equipment or portions of hot bench mock-up are unavailable.
Other Engineering Support	
Compilation	Provide compilation and assembly capability for software generated in DoD-approved HOLs.
ECS and ISS Documentation Maintenance	Provide a capability to enter, edit, and produce system documentation. This includes the capability to insert, delete, modify, tabulate, paginate, search the text, and provide headers and footings.
ISS Configuration Management	Provide maintenance and monitoring of ISS hardware configurations (e.g., ISS wirelists) and provide engineering drawings for layouts and wire runs.
Training	Provide interactive, programmed instruction in the use of the support processor.
Software Code Analysis	Provide syntactic and semantic analysis and optimization of software.
Software Performance Analysis	Provide a capability to analyze software implementations to determine choke points, frequency of code execution, instruction timings, and other performance parameters in order to fine tune the software in response to changing requirements.
System Modeling	Provide off-line simulation to evaluate system design and software implementations.

(continued)

Table 4-5. (continued)	
Requirement	Description
Other Engineering Support (continued)	
Software Conversion Support	Provide syntactic analysis and translation of software languages for conversion of ISS or support processors.
Program Support Library	Provide a central library and code control for current software, test data, and scenarios.
Software Archive	Provide a back-up software archive and data management function.
Division Management Support	
Project Control	Provide for monitoring of assigned section projects. This includes tracking of milestones and dates and monitoring of resource assignment. The capability should allow planning and analysis, e.g., PERT or critical path modeling. It should also provide the ability to produce graphic representations of the project schedules.
Configuration Management	Provide for automated support of the configuration management process, including ECP initiation and tracking, suspense management, CPCS agenda development, block-cycle reporting.
Document Control	Provide capability to identify, catalog, and locate system ECS and ISS documentation.
Logistics Management Support	
Budget Preparation	Provide automated maintenance of the program budget data base and creation of budgetary submissions and consolidate data for all budget sources.

(continued)

Table 4-5. (continued)	
Requirement	Description
Logistics Management Support (continued)	
Life-Cycle-Cost Analysis	Provide a model for projection of system life-cycle costs based on varying support concepts, program and equipment changes, and changes in requirements parameters.
Procurement Preparation	Provide for automated support to develop Contract Data Requirements List (CDRL). Standard packages of data item descriptions would be developed and maintained for selection, modification, or inclusion in the procurement package.
System History	Provide capability to create an automated audit trail of program budget, logistics, and technical actions. The function would allow continuity of program processes even though personnel might shift.
Logistics Support Data Base	<p>Provide an automated parts reference data base to include:</p> <ul style="list-style-type: none"> • Parts Numbers • Descriptive Data • Maintenance/Repair Codes • Requirements Factors • Interchangeability • Special Tools <p>The requirement would also provide Logistics Support Analysis (LSA) records and level-of-repair (LOR) analysis.</p>
GFE Accountability	Provide identification and scheduling of GFE requirements and monitoring status and accountability and disposition of GFE items.
Repair Restrictions Data Base	Provide a reference of NSN repair restrictions by system and aircraft type.

(continued)

Table 4-5. (continued)	
Requirement	Description
Logistics Management Support (continued)	
Checkbook	Provide MMR personnel with budgetary "checkbooks" to account for the status of funds by source, type, recipient, and purpose, and to provide an audit trail of budgetary actions.
Suspense Tracking	Provide for establishment of suspense items and notification of related threshold and exception conditions.
Automated Mail System	Provide a means for rapid distribution of internal mail, assignment and tracking of associated suspenses, creation of audit trails, and notification of recipients.
Implied Functions	
Security*	Provide system, program, and data access control, and implement appropriate output and data safeguards as required by system architecture.
System Management	Determine system usage by EW system, user, and individual; monitor system performance (e.g., I/O wait times, memory allocations, throughput); and dynamically control system resources.
Cost Accounting	Provide a cost accrual and estimation system. Costs must be accrued by project, individual system, and budgetary source. The system will also provide internal planning data.
*Security was not included in the priority-setting survey, since it is a mandated, yet architecture-dependent function.	

Table 4-6. PRIORITIES OF REQUIREMENTS

Function	Priority Rankings			
	Including MMEC		Not Including MMEC	
	$\bar{\chi}^*$	σ_n^{**}	$\bar{\chi}^*$	σ_n^{**}
Threat Data Base Maintenance	5.1	6.3	2.8	2.4
Data Reduction/Analysis	7.8	5.7	5.8	2.0
Cross Compilation/Assembly	8.2	7.1	7.3	6.1
V&V Tracking	8.5	4.0	6.9	2.3
Text/File Edit	9.1	8.2	11.8	7.8
Compilation	10.2	4.3	10.0	4.9
V&V Test Support	10.5	10.7	11.7	12.0
Program Support Library	10.9	5.5	9.8	5.3
ECS and ISS Documentation Maintenance	11.1	5.4	12.5	4.9
Software Archive	11.1	5.4	10.7	5.3
Automatic Software Documentation	11.7	10.1	13.2	11.3
Change Distribution	11.9	7.5	9.5	3.4
Configuration Management	12.1	12.3	14.2	13.5
Software Code Analysis	12.5	6.3	11.5	2.3
Software Performance Analysis	13.1	5.9	12.3	2.6
ISS Configuration Management	14.5	6.3	12.5	5.6
Software Conversion Support	16.4	8.3	13.7	4.3
System Modeling	17.9	5.8	15.7	5.0
On-Line Simulation	18.8	11.8	17.7	9.8
Data Table Generation	20.1	10.9	22.0	11.0
$\bar{\chi}^*$ = mean ranking. σ_n^{**} = standard deviation.				

(continued)

Table 4-6. (continued)				
Function	Priority Rankings			
	Including MMEC		Not Including MMEC	
	$\bar{\chi}^*$	σ_n^{**}	$\bar{\chi}^*$	σ_n^{**}
Project Control	21.5	10.4	19.8	11.1
Training	22.0	7.8	22.8	7.5
System Management	22.8	7.8	23.8	7.9
Emulation	22.8	12.9	23.7	11.0
Budget Preparation	24.1	5.9	26.7	4.5
Document Control	24.4	10.2	24.5	11.1
Checkbook	25.3	10.4	24.3	11.5
Procurement Preparation	25.7	6.1	27.2	5.4
Cost Accounting	25.9	9.7	24.8	10.6
Life-Cycle-Cost Analysis	28.0	5.1	28.2	2.7
Suspense Tracking	28.0	10.5	27.8	11.5
System History	28.6	4.5	27.2	4.4
Documentation Archive	28.7	4.2	27.6	4.5
Logistics Support Data Base	29.0	4.8	29.2	2.0
GFE Accountability	29.3	1.7	29.6	1.9
Repair Restrictions Data Base	29.7	2.4	28.8	1.2
Automated Mail System	31.0	9.8	29.5	10.8
$\bar{\chi}^*$ = mean ranking. σ_n^{**} = standard deviation.				

restored the Checkbook Function to the desired list. The functions were divided into three categories -- required, desired, and identified -- and reviewed for unique application to the EWAISF. The resulting validated requirements are shown in Tables 4-7, 4-8, and 4-9. Those requirements shown in Table 4-9, Identified Functions, while validated as MMR requirements, were eliminated from further consideration of this study. It was determined that these functions would be "addressed more appropriately in a separate forum."

*EWAISF Committee Meeting Minutes, 9 April 1981, dated 16 April 1981.

Table 4-7. REQUIRED FUNCTIONS
Software Change Support
Text/File Edit Cross Compilation/Assembly Automatic Software Documentation Threat Data Base Maintenance Data Reduction/Analysis V&V Test Support Change Distribution Data Table Generation
Other Engineering Support
Compilation ECS and ISS Documentation Maintenance ISS Configuration Maintenance Training Software Code Analysis Software Performance Analysis Software Conversion Support Program Support Library Software Archive
Division Management Support
Project Control Configuration Management Document Control
Implied Functions
Security System Management Cost Accounting

Table 4-8. DESIRED FUNCTIONS
Software Change Support
On-Line Simulation V&V Tracking Emulation
Other Engineering Support
System Modeling
Logistics Management Support
Budget Preparation Life-Cycle-Cost Analysis Procurement Preparation Checkbook

Table 4-9. IDENTIFIED FUNCTIONS*
Logistics Management
Program History Logistics Support Data Base GFE Accountability Repair Restrictions Data Base Suspense Tracking Automated Mail System
*These functions are not to be considered in the remainder of this study.

Composite specifications for the required functions are contained in Appendix B, Figures B-1 through B-23, and for the desired functions in Figures B-24 through B-31. The information presented in these figures is described in Section 3.2.

4.2.4 ADPE and Software Requirements

The first two phases of this study have dealt primarily with identifying and validating a set of functional requirements for an EWAISF support processor. The conclusion of Phase 2 (Requirements Analysis) provides the basis for development of architectural alternatives for a support processor. Therefore, it is necessary to translate the validated functional requirements into computer processing terms to support the alternative development. These ADPE and software requirements, as synthesized from the functional requirements, are presented in four general categories -- generalized support software, applications software, operating system and executive software, and equipment requirements. These requirements have been synthesized by the author on the basis of experience.

4.2.4.1 Generalized Support Software

Generalized support software, for the purpose of this study, is defined as software capable of supporting multiple applications without modification. Inspection of the validated definitions of required and desired functions identified the following generalized software capabilities as being required in the EWAISF support processor:

- Data Base Management System
- Text/File Editor
- Document Processor
- Compilers and Assemblers
- Static and Dynamic Code Analyzers
- Statistical Analysis Library
- Emulation Compiler

The data base management system (DBMS) should furnish data definition, maintenance, and retrieval services to the various applications software resident in the support processor, as well as interactive-user data storage and retrieval and source data for other processors. The DBMS should have the capability to define data items and their characteristics and the relationships of data items and groups of data items. These definitions should give the user or programmer symbolic, device-independent data access. The data bases identified or projected to date pose no requirements that would dictate a particular structure, e.g., chained, hierarchical, or networked records. However, the DBMS should permit linked, multifile relationships. The data definition capability, in addition to permitting standard data-item-attribute definitions and record-structuring, should also provide data-access security specifications at least to the data-base level, by user. The definition capability should be interactive and easily understood

and used by nonprogramming personnel. The system should readily prompt users for required definition information and should permit immediate interactive correction of definition errors. The DBMS must provide interactive-user data maintenance facilities as well as program-callable data services. In addition to normal record and data-item maintenance features, the DBMS should permit redefining data structures, bulk-load data bases, and copy and subset data bases, and creating audit trails of maintenance actions. The DBMS must have features that ensure integrity of the data base, including checkpoint, save and restore, and data pointer analysis.

The text/file editor must have the capability to create and maintain source data, program files, and document text. This feature should permit text entry, edit (add, delete, and change), text search on character strings, and replacement and movement of text. Auxiliary features include bulk-data-loading, file save and restoration, and cataloging. This capability must include maintenance of variable-length records. In addition, a page-formatting and -editing capability is required to permit interactive definition of screen formats, field protection, and field data types.

The document processor should facilitate the automatic generation and maintenance of system documentation. It may interface with the text editor but could utilize its own input source. It must provide a facile interface for clerical personnel for the formatting and maintenance of documentation. Specifically, the document processor must have a capability for interface to the DBMS or text/file editor for data extraction; document formatting to include insertion, deletion, modification, tabulation, pagination, headings, and footings; provision for including figures and tables; and automated interface to software documentation tools. It should provide a text search on character strings or Key-Word-In-Context and an automated indexing of key terms. The processor should provide for identification and dating of document versions.

Two classes of compilers and assemblers must be provided by the EWAISF support processor. The first class consists of the support processor assembler and HOL language compilers to support development of software tools. The second class consists of cross compilers and assemblers for the system target processors identified in Table 4-1 and for the ECS/ISS host processors. HOLs for which compilation must be provided include FORTRAN IV, COBOL, Ada, JOVIAL J(73), Pascal, CMS-2, and FORTH. Compiler and assembler provisions must readily accommodate changes in system processors and ECS/ISS host processors.

Code analyzers must provide two distinct capabilities: (1) analysis of source code for quality control, verification, and optimization, and (2) dynamic analysis of executing software to determine performance parameters in an operating environment. The source code analyzers must be capable of checking language syntax for correctness and adherence to standards, logic flow, and variable usage. The analyzers should also permit local and global code optimization through identification of common software. Dynamic-performance-analysis software should be capable of collecting, formatting,

and presenting execution statistics that show frequency of execution of software routines, processing and I/O times by routine, wait-state durations, and memory utilization. This software is oriented to the applications programs and is independent of the normal, operating-system-accounting functions.

The statistical analysis software must permit examining an input data set, sorting the set on multiple data fields in either ascending or descending order, and selecting items of information to create subsets of the input data sets. This feature must be able to do the following:

- Perform counts and totals
- Perform curve-fitting algorithms
- Compute standard statistical parameters
- Format the input data and derived statistics for presentation in both tabular and graphic forms
- Interface with the document processor for inclusion of tables and figures in documentation
- Accept data from a variety of sources, including hot bench mock-ups, flight-test recording media, and dynamic software analysis packages

The emulation compiler is a requisite capability for the implementation of a generalized processor emulation capability. This feature defines the architecture and instruction set of the emulated processor to the emulator host processor. The compiler must be capable of accepting the definition via an input data set and producing microcode capable of performing all emulated processor instructions.

4.2.4.2 Applications Software

Applications software consists of software unique to the support of a single functional requirement. These packages may be commercially available or may require development. Applications software may also utilize the generalized support software, as well as executive and operating-system-software services, in accomplishing its function. Applications software will be required to support the following functions:

- Automatic software documentation
- Data reduction/analysis
- V&V test support
- Change distribution
- Data table generation
- ISS configuration management
- Training

- Program support library
- Configuration management
- Document control
- On-line simulation
- V&V tracking
- System modeling
- Budget cycle preparation
- Life-cycle-cost analysis
- Procurement preparation
- Checkbook maintenance

These application packages vary widely in size and complexity. Almost all require an interactive interface. More than 50 percent require an interface to the data base management system, including applications-unique data base definitions, editing criteria, maintenance, and extraction and sort routines. Several could utilize the report-generation capability of the document processor. Table 4-10 characterizes the applications packages, including estimates of their use of generalized support software and sizes in terms of lines of code.

4.2.4.3 Operating System and Executive Software

The operating system (OS) and executive software for the support processor must provide multiprogramming support in batch and interactive modes. The OS must permit program initiation and normal and abnormal termination (including fault-trapping), as well as management of main and peripheral resources (including allocation and de-allocation of memory and peripherals). It must have the capability for interface to the various ISS ECS processors and peripheral support to mass storage, display, and record devices. It must provide data management (file and record) services to applications programs, as well as interprocess communications.

In addition to the normal operating system services, the support processor must offer security, system management, and cost-accounting functions. Security includes system access control, output labeling and control, and data security and integrity functions for both covert and inadvertent compromise situations. All security software must be capable of modification to satisfy the requirements for the mode of operation in which the system operates. The system must permit monitoring system component usage, recording and analyzing faults, and isolating failed components from the system. The OS must provide the capability to implement a usage-accounting algorithm for analyzing system operating costs.

Most if not all of the above requirements are satisfied in one form or another by commercially available operating systems. Some executive software is still required to implement these functions but is dependent on the architecture selected.

Table 4-10. APPLICATIONS SOFTWARE									
Application	Generalized Software Usage						Estimated Size (Lines of Code)		
	Data Base Management System	Document Processor	Text/File Editor	Code Analyzers	Statistical Analysis Library		0 to 1,000	1,000 to 5,000	>5,000
Automatic Software Docu- mentation		X	X					X	
Data Reduction/Analysis	X	X			X			X	
V&V Test Support	X			X					X
Change Distribution							X		
Data Table Generation	X		X				X		
ISS Configuration Management	X	X						X	
Training	X								X
Program Support Library			X						X
Project Control	X	X							X
Configuration Management	X	X						X	
Document Control	X	X					X		
On-Line Simulation	X								X
V&V Tracking	X	X					X		
System Modeling									X
Budget Cycle Preparation	X	X						X	
Life-Cycle-Cost Analysis	X	X			X			X	
Procurement Preparation		X						X	
Checkbook Maintenance	X	X					X		

4.2.4.4 ADPE Requirements

To a large extent, equipment requirements are dependent on the architecture to be implemented. However, certain general requirements can be derived on the basis of functional requirements. Required characteristics of the support ADPE for the EWASIF are presented in this section for the processors, mass storage, user terminals, display devices, and communications. In establishing the ADPE requirements, the following assumptions have been made:

- The EWASIF workload is a direct function of the number of systems supported.
- The software change function will be carried out primarily on the ISS processors.
- The support processors will be interactively accessed by one terminal for every two systems at any given time.
- During emergency change conditions, each individual using the support processors will require daily access.
- Mass storage will be required for all functional data bases (e.g., EWIR) for all current versions of EW systems and ISS documentation.
- ISS processors will be linked to the support processors for data transfer, including software updates, documentation updates, and base retrievals.
- The engineering function will be wholly contained within controlled areas.
- To the extent practicable, the alternative architectures will be compatible with planned ISS processor architectures.

Given these assumptions, the ADPE requirements have been derived as described in the following paragraphs.

Processors

The processors providing the EWASIF support functions can be characterized in the following terms -- speed, memory, and data types. If it is assumed (1) that one-half of the systems will be using the support processor capability at a given time, (2) that one-half of the interactive terminals are attached, (3) that the average process requires 25 iterations of one-half its code, (4) that the average process size is 5,000 instructions (see Table 4-10), (5) that system overhead is 25 percent, and (6) that system growth is anticipated to be 50 percent, then the following processor speed requirement can be calculated on the basis of a two-second response time:

$$\begin{aligned}\text{Instructions per second} &= (16 \text{ systems} \div 2) \\ &\quad \times (25 \text{ iterations per system}) \\ &\quad \times (5,000 \text{ instructions per iteration} \div 2) \\ &\quad \times (1.25 \text{ overhead}) \times (1.5 \text{ growth}) \div (2 \text{ seconds}) \\ &= 468,750\end{aligned}$$

For a single processor, this processing rate requires an instruction execution time of approximately two microseconds.

The required main memory capacity of the system is a function of the architecture selected, the speed of the processors, and the type of operating system used (physical versus virtual memory). A static memory requirement (i.e., one that does not impact the speed requirement previously identified) can be calculated from the following assumptions:

- One-half of the EW system processors are using the support processors at a given time.
- Time-sharing or terminal-handling processes are always active, as are the operating system, accounting, and diagnostic software, and require memory equal to 25 percent of the applications memory requirement.
- The average process contains 5,000 instructions of 1-1/2 word lengths.
- Data areas for each process are ten times the size of the instruction area.
- A 50 percent growth is anticipated.

The memory requirement can then be calculated as follows:

$$\begin{aligned}\text{Words of main memory} &= (16 \text{ systems} \div 2) \times (1.25 \text{ overhead}) \\ &\quad \times (7,500 \text{ instruction words per system}) \\ &\quad \times (11 \text{ words per instruction word}) \times (1.5 \text{ growth}) \\ &= 1,237,500 \text{ words}\end{aligned}$$

This requirement can be adjusted on the basis of operating system or architecture. The word size of the processor should be sufficient for 32-bit arithmetic in either single- or double-word mode.

The processor will support data base and computation applications and therefore must provide a variety of data types, including integer, floating point, bit strings, character strings, and packed decimal. If the word length of the processor is 16 bits, a double-word, floating-point capability must be provided.

Mass Storage

The mass storage available for the support processors must provide both on-line and archival storage capability. Archival storage can be provided by magnetic tape units. Assuming that one-half of the systems are actively using the support processors, that one-fourth of these require archival storage, and that two drives are available for system usage, then a minimum of four tape drives would be required. On-line storage would consist of magnetic disk. The EW systems' Resource Acquisition Management Plans (RAMPs) indicate an ISS magnetic disk storage capability ranging

from 10^6 bytes to 8×10^6 bytes. Using an average figure of 30 Mbytes per system and 16 systems yields a requirement for 480 Mbytes of on-line storage for an EW system and for ISS software and data back-up. An earlier EWAISF documentation study estimated 30 man-years of documentation input time, based on a typing speed of 50 words per minute, 5 characters per word, and 2,000 man-hours per man-year. Therefore, the total number of characters of documentation is:

$$\begin{aligned} & (30 \text{ man-years}) \times (2,000 \text{ man-hours per man-year}) \\ & \times (60 \text{ minutes per man-hour}) \times (50 \text{ words per minute}) \\ & \times (5 \text{ characters per word}) \\ & = 900 \times 10^6 \text{ characters} = 900 \text{ Mbytes storage} \end{aligned}$$

Thus the total disk storage requirement is 1,380 Mbytes plus 25 percent overhead for a total of 1,725 Mbytes.

User Terminals

User terminals will be required to support each system as well as the engineering management functions. It is assumed that 8 of the 16 supported systems will require 1 terminal, and 8 will require 2 terminals, for a total of 24 terminals. In addition, engineering management will require 1 terminal each for branch and section chief, for a total of 7. Requirements for terminals to support the software support organizations will depend on the software support concept employed. However, for preliminary sizing purposes, an estimate of 10 terminals for the support function is assumed, which allows for some pooling of terminal resources for overflow usage. The total terminal requirement is 41.

The physical characteristics of the terminals are dependent on the architecture (e.g., smart versus dumb), but some can be specified. Each terminal should provide a CRT display of at least 80 characters by 20 lines and should be capable of displaying the complete seven-bit ASCII character set (128 codes). Graphics display is not a requirement but is a desirable attribute. Standard keyboard data entry is required, and programmable function keys are desirable. For those terminals in the engineering management area, a forms capability with protected fields is desirable.

Display Devices

Required display devices include printers and plotter graphics. The stated requirement of local print capability has security ramifications that are architecture-dependent. On the basis of current usage, it is apparent that two high-speed line printers (more than 1,000 lines per minute) should be adequate to provide centralized printing capability. If security considerations do not preclude establishment of remote print facilities (one printer per floor), then a local print capability of 400 to 600 lines per minute should be sufficient for small print files. The two high-speed printers (based on 1,400 lines per minute) would

provide a one-shift print capability of 168 million lines per year based on a 50 percent duty cycle. The initial documentation entry is the largest print requirement, with 36 million lines. A single, large flatbed plotter should be adequate for all large-scale plot requirements. However, if user terminals with graphics capability are acquired, a graphics-capable page-print device (for such items as milestone charts) should be provided.

Communications

Communications requirements for the system include the support of all interactive terminals at a 2,400 baud rate on a 50 percent duty cycle. In addition, medium-speed interfaces (9,600 to 19,200 baud) should provide adequate data transfer between the support processors and the ISS edit control station processors. The major high-speed interface requirement is the interface between the support processors and the emulation processor for environmental simulation, which is architecture-dependent. This will require an interface of 100 Kbaud or faster.

CHAPTER FIVE

ALTERNATIVE SUPPORT ARCHITECTURES

Phase 3, Alternatives Definition, provides alternative architectures for implementing the EWAISF support functions identified and validated in Phases 1 and 2 of this effort. These architectures, in addition to responding to the support functional requirements, consider the ADPE and software requirements synthesized in Phase 2. The alternatives form the basis for the cost-benefit analysis performed in Phase 4. The alternatives identified in this phase were not restricted by existing modes of operation. Four initial architectures were identified, as follows:

- Independent. This architecture is characterized by the absence of control or physical connectivity between systems and the support processors. It utilizes one large mainframe in a manner similar to the current operation.
- Federated (Single Processor). This architecture would employ a large mainframe computer in a loosely coupled EWAISF operation. (In this context, loosely coupled signifies connectivity for the purpose of data, but not for control flow).
- Federated (Multiple Processor). This architecture would consist of functionally distributed multiple processors of a smaller size than that of the single-processor configuration. This set of processors would constitute the support processor function.
- Integrated. This architecture would integrate the EWAISF support functions in a workload distribution network consisting of the ISS processors and augmented, as required, to provide the necessary processing power.

The requirements identified in Phases 1 and 2 necessitate data links between the support processor and the ISS processors for on-line data transfer, update, and inquiry functions. The Independent Architecture does not provide the required connectivity, and was, therefore, eliminated from further consideration.

The remaining three architectures were presented to the ISS Support Subcommittee at its regularly scheduled June meeting. At this meeting, it was concluded that the Integrated Architecture had substantial technical risk and was probably not affordable. This architecture was subsequently

replaced by a federated architecture employing front-end processors for terminal management and coordination of common processes between the support processors and the ISS processors. Thus three federated architectures were approved for further consideration:

- Single processor
- Multiple processor
- Front-end processors

Each of these architectures is defined, in terms of concept, components, and interfaces, in greater detail in the following sections. These architectures will be subsequently evaluated in Phase 4 -- Cost-Benefit Analysis. Phase 4 will address low- and high-cost options for each architecture. The low-cost options will implement those functions validated as required in Phase 2. The high-cost options will implement the required functions and also those functions validated as desired.

5.1 SINGLE-PROCESSOR ARCHITECTURE

5.1.1 Concept

As mentioned previously, the Single-Processor Architecture is based on a single, large mainframe computer that is used to provide all EWALSF support data and computation functions. These functions would be established in a separate support processor organization that provides interactive processing support to engineering personnel and over-the-counter service for output control and batch job submissions. In the high-cost option, a separate emulation processor is added. Environmental simulation for this processor would be provided by the mainframe processor. It is possible, despite sizing estimates, that during an emulation, the mainframe processor would need to be dedicated for environmental simulation.

The user interface would be provided by directly attached interactive terminals. The terminals would be dedicated to support processor access. The ISS processors would also be linked to the mainframe computer for data transfer functions. This transfer would permit transmission of print files for printing on the ISS printers.

Operational support of the support processor would be provided by the support processor organization. Operational support of the ISS computer systems would be provided by the engineers assigned to the systems, which reflects the current support concept.

Security aspects of this architecture include the following:

- All support processor operations would be centrally located.
- No terminal equipments would require interfaces that would exit the controlled areas.
- Physical security would be accomplished in the current manner.
- TEMPEST requirements would be satisfied in the current manner.

Figure 5-1 is a block diagram of the Single-Processor Architecture. This architecture consists of processors, interactive terminals, an archival storage subsystem, an on-line mass storage subsystem, a hard-copy display subsystem, and associated communications and software.

5.1.2 System Components

The components that constitute the support processor subsystems are described in the following paragraphs.

5.1.2.1 Processors

The mainframe processor must be capable of providing an instruction rate of 500,000 instructions per second to fulfill the interactive and batch processing requirement. Additional throughput capability is required in the high-cost option to provide the environmental simulation for the emulation processor. The processor must be capable of supporting (1) 1.25 Mbytes of main memory, (2) a very high-speed programmable interface to act as the environmental simulator for the emulator processor in the high-cost option, (3) 50 terminals on a 50 percent duty cycle at a 2,400 baud rate, and (4) up to 16 medium-speed interfaces to ISS processors. The processor architecture should allow the attachment of multiple-unit record devices, and it should be capable of attaching as many as 20 disk drives. Table 5-1 is a representative list of computer systems that could fulfill these requirements.

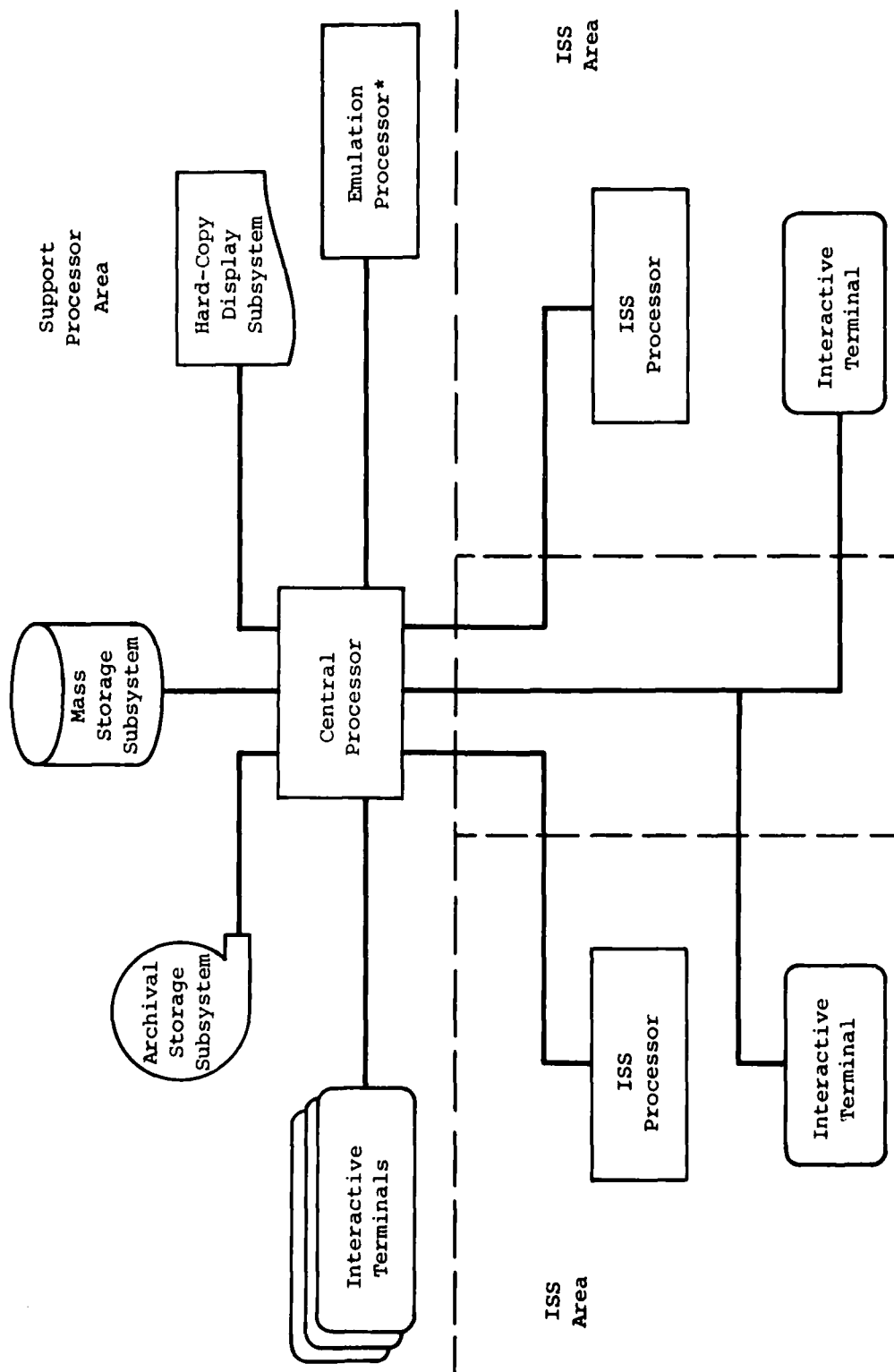
In the high-cost option of the Single-Processor Architecture, a micro-programmable emulation processor is required, which would have characteristics similar to the QM-1 processor employed by WR-ALC-MMEC.

5.1.2.2 Peripherals

Peripheral devices constitute the archival storage, on-line mass storage, hard-copy display, and user terminal subsystems include tape drive units, magnetic disk units, line printers, graphic plotters, and alphanumeric and graphic CRTs. The archival storage subsystem must provide at least two 7-track tape drives and four 9-track tape drives. Whenever a dedicated tape unit is required for off-line communications interface, an additional drive will be required. The minimum set will permit seven track applications, system checkpointing and journaling, and two concurrent applications tape mounts, which might restrict tape usage to one process at a time.

The on-line mass storage subsystem must provide direct-access storage capability for up to 2,000 Mbytes. For the purposes of this study it is assumed that the storage media would be magnetic disk, requiring 8 to 12 disk drives. However, it should be noted that the rapid advances in memory technology, particularly the development of magnetic bubble memory, would probably continue. Therefore, this is one area in which technological change might affect the architecture identified in this study.

The hard-copy display subsystem will provide centralized printer and graphic outputs. This capability would be collocated in the support processor facility. No remote print capability is provided by this architecture. The hard-copy display subsystem consists of two high-speed line printers



*High-cost option.

Figure 5-1. SINGLE-PROCESSOR ARCHITECTURE

Table 5-1. REPRESENTATIVE MAINFRAME COMPUTER SYSTEMS			
Manufacturer	Model	Word Length (Bits)	Maximum Memory (Mbytes)
Andahl	470V/5	64	8.0
Control Data Corporation	Cyber 170	24	2.6
Cray Research, Inc.	Cray-1S	64	4.0
Digital Equipment Corporation	1060/1070	32	4.0
	2040/2060	32	3.0
Honeywell	Level 66 DPS	8*	8.0
IBM	3031	32	8.0
	3032	64	8.0
Sperry Univac	1100/60	32	2.0
	1100/80	32	4.0
*Single byte addressability.			

(>1,000 lines per minute) and one plotter. No requirement for punched card or punched paper tape is currently anticipated.

The user terminals include a mix of alphanumeric and graphics terminals. The EW system would have access to alphanumeric terminals, and engineering management would have access to graphics terminals. Each terminal would have a standard ASCII keyboard. Graphics terminals ("dumb terminals") would be equipped with a page-print device and would have minimal formatting and editing capability. Buffering, function key, and character and line editing would also be provided.

5.1.2.3 Communications

The Single-Processor Architecture does not employ a networking scheme as such. In this architecture, interfaces with other processors are treated as remote terminal interfaces. Medium-speed (20 to 50 Kbaud) processor-to-processor data links will be provided for file and software data transfer. Communications would also be required for user terminal-to-processor functions. This architecture would have to support 50 terminals operating at 2,400 baud on a 50 percent duty cycle. Communications with systems external to the EWASIF would be off-line via magnetic tape. The system will operate internally to a single controlled area; therefore, special security features (e.g., encryption) will not be required.

5.1.2.4 Software

The software required to implement the validated functions was described in Chapter Four. The operating system requirements of this architecture are characteristically satisfied by those supplied with the representative computer systems shown in Table 5-1. The architecture imposes no unusual executive or control requirements on the operating system or other support software.

5.2 MULTIPLE-PROCESSOR ARCHITECTURE

5.2.1 Concept

The Multiple-Processor Architecture is based on a functionally distributed network of minicomputers having shared access to peripheral devices. This architecture provides two high-end minicomputers that support the data and computation functions. In the high-cost option, a separate emulation processor is added. Functions are divided between the processors, which are based on the degree to which they are data-handling oriented or computationally oriented. One of the processors becomes, in effect, a data processing machine, and the other processor becomes a scientific machine. The scientific machine serves as the environmental simulator for the emulation process in the high-cost option.

User interface would be provided by directly attached, dedicated interactive terminals. Terminal attachment would be divided between the two processors. ISS processors would be linked to the data processing machine. Print files could be transmitted to ISS processors for local printing.

Operational support of the support processor would be provided by a support processor organization. Operational support of the ISS computer systems would be provided by the engineers assigned to the systems, which reflects the current support concept.

Security aspects of this architecture are similar to the Single-Processor Architecture and include the following:

- All support processor operations would be centrally located.
- No terminal equipments would require interfaces that would exit the controlled area.
- Physical security would be accomplished in the current manner.
- TEMPEST requirements would be satisfied in the current manner.

Figure 5-2 is a block diagram of the Multiple-Processor Architecture. This architecture consists of processors, interactive terminals, an archival storage subsystem, an on-line mass storage subsystem, a hard-copy display subsystem, and associated communications and software.

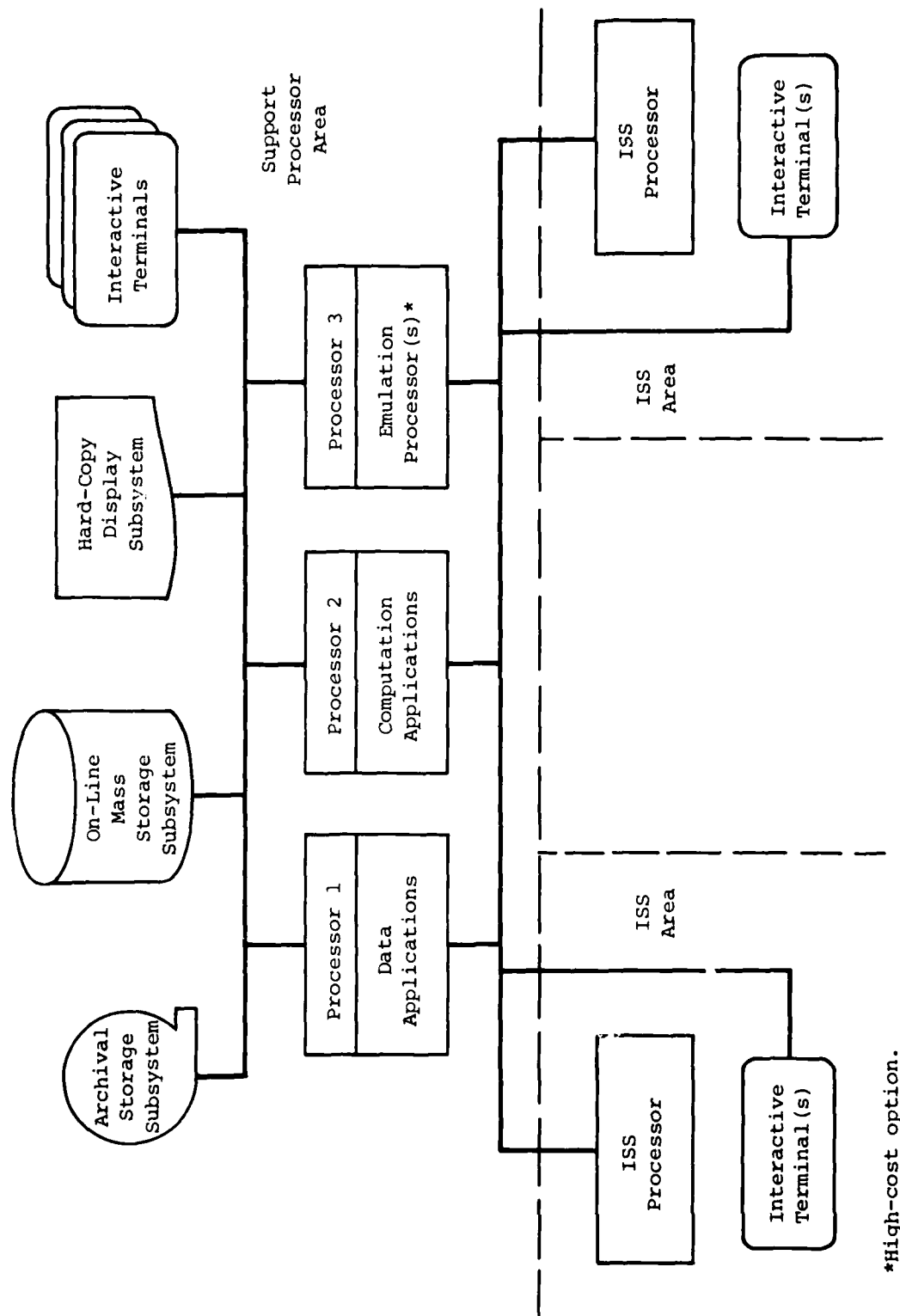


Figure 5-2. MULTIPLE-PROCESSOR ARCHITECTURE

5.2.2 System Components

The components that constitute the support processor subsystems are described in the following paragraphs.

5.2.2.1 Processors

The combined processors must be capable of providing an instruction rate of 500,000 instructions per second to fulfill the interactive and batch processing requirement. Additional throughput capability is required in the high-cost option to provide the environmental simulation for the emulation processor. Both the data-handling and computation processors should be capable of supporting 25 terminals on a 50 percent duty cycle at a 2,400 baud rate. The data-handling processor must be able to support up to 16 medium-speed interfaces to the ISS processors. The scientific machine must be capable of supporting a very high-speed interface to the emulation processor in the high-cost options. Each processor should be capable of attaching up to 20 disk drives as well as multiple-unit record devices. Table 5-2 is a representative list of computer systems capable of fulfilling these requirements.

Table 5-2. REPRESENTATIVE HIGH-END MINICOMPUTER SYSTEMS			
Manufacturer	Model	Word Length (Bits)	Maximum Memory (Mbytes)
Burroughs Corporation	B-1985	16	4.0
	B-3950	16	5.0
Data General	ECLIPSE M/600	16	2.0
	ECLIPSE S/250	16	2.0
	ECLIPSE MV/8000	32	2.0
Digital Equipment Corporation	PDP 11/70	16	2.0
	VAX-11/750	32	2.0
	VAX-11/780	32	8.0
Harris Corporation	300	24	2.0
Hewlett-Packard Company	HP 3000	16	4.0
Honeywell	Level 6	16	1.0
Modular Computer Systems	Classic 7860	16	4.0
			4.0
Prime Computer, Inc.	Series 50	32	8.0
Tandem Computers	Non-Stop System	16	32.0*
*2 Mbytes per processor; up to 16 processors per configuration.			

In the high-cost option of the Multiple-Processor Architecture, a microprogrammable emulation processor is required, which would have characteristics similar to the QM-1 processor employed by WR-ALC/MMEC.

5.2.2.2 Peripherals

Peripheral requirements for the Multiple-Processor Architecture are the same as those for the Single-Processor Architecture, with the following additional requirements: (1) additional tape drive units will be required to support the additional processor, and (2) all peripherals must be accessible from multiple processors, i.e., multiported.

5.2.2.3 Communications

Data communications for the Multiple-Processor Architecture are essentially the same as those for the Single-Processor Architecture, with the following exceptions: (1) a high-speed interface must be provided for communications between the data-handling processor and the scientific processor to retrieve data from the support processor data base, which uses the services of the data-handling processor; and (2) both processors require interfaces for terminal handling.

In the high-cost option, the scientific processor will have a high-speed interface to the emulation processor. The 16 ISS processor links will be terminated in the data-handling processor. Again, communications with external systems will be off-line via magnetic tape. The system will operate internally to a single controlled area, and secure, encrypted communications will not be required.

5.2.2.4 Software

The software required to implement the validated functions was described in Chapter Four. The operating system requirements of this architecture are characteristically satisfied by those supplied with the representative computer subsystems identified in Table 5-2. However, in addition to the operating system services, both the data-handling and scientific processors will require terminal management software for routing terminal task requests, user inputs, and processor outputs. This will enable the terminal user to execute a task in either processor, independent of the physical connectivity of the terminal. Some software is available for computers, such as those identified in Table 5-2, which provides basic services that permit the terminal management and task routing algorithms to be readily implemented. Among these software packages are Digital Equipment Corporation's DECNET and Hewlett-Packard's DS/3000.

5.3 FRONT-END PROCESSOR ARCHITECTURE

5.3.1 Concept

The Front-End Processor Architecture is characterized by the use of a common user interface for both the ISS processor and the support processor.

Except for the terminal functions, the Front-End Processor Architecture can use either the Single-Processor or the Multiple-Processor Architectures as a basis for providing data-handling and computation capabilities. For the purposes of this study, it can be assumed that the Multiple-Processor Architecture will be used for all services other than terminal-handling functions. In the high-cost option a separate emulation processor is added, and the computation computer provides environmental simulation. These functions would be established in a support processor organization, which would centralize support of operating systems and software tools development.

The user interface would be provided by attaching the interactive terminals to front-end processors, which are then attached to the ISS and support processors. The front-end processors would provide a single-user interface to the EWAISF that would be transparent to the user with respect to where a particular function was being performed. The front-end processors constitute a User Interface Subsystem that routes user task requests, data inquiries, and output to and from the appropriate processor.

Security aspects of this architecture have one major difference from those of the other architectures. A front-end processor would be located on each floor, which would permit attachment of local hard-copy capability on each floor. Print files could also be transmitted to ISS processors for local printing. This would imply that the necessary control of output and security of system operation would be established in each location; i.e., a small computer operation would be established on each floor. This arrangement has been assumed for the Front-End Processor Architecture. Other aspects of the architecture include the following:

- No terminal or processor interfaces would exit the controlled area.
- Physical security would be performed in the current manner.
- TEMPEST requirements would be satisfied in the current manner.

Figure 5-3 is a block diagram of the Multiple-Processor Architecture. This architecture consists of processors, interactive terminals, a User Interface Subsystem, an archival storage subsystem, an on-line mass storage subsystem, a hard-copy display subsystem, and associated communications and software. The central processor shown in Figure 5-3 could consist of either of the processor configurations used in the Single-Processor or Multiple-Processor Architectures. For this alternative, the multiple-processor configuration has been chosen.

5.3.2 System Components

The components that constitute the support processor subsystems are described in the following paragraphs.

5.3.2.1 Processors

The central processor requirements of this alternative are similar to the Multiple-Processor Architecture, with certain key differences. The instruction rate for interactive and batch processing is still 500,000

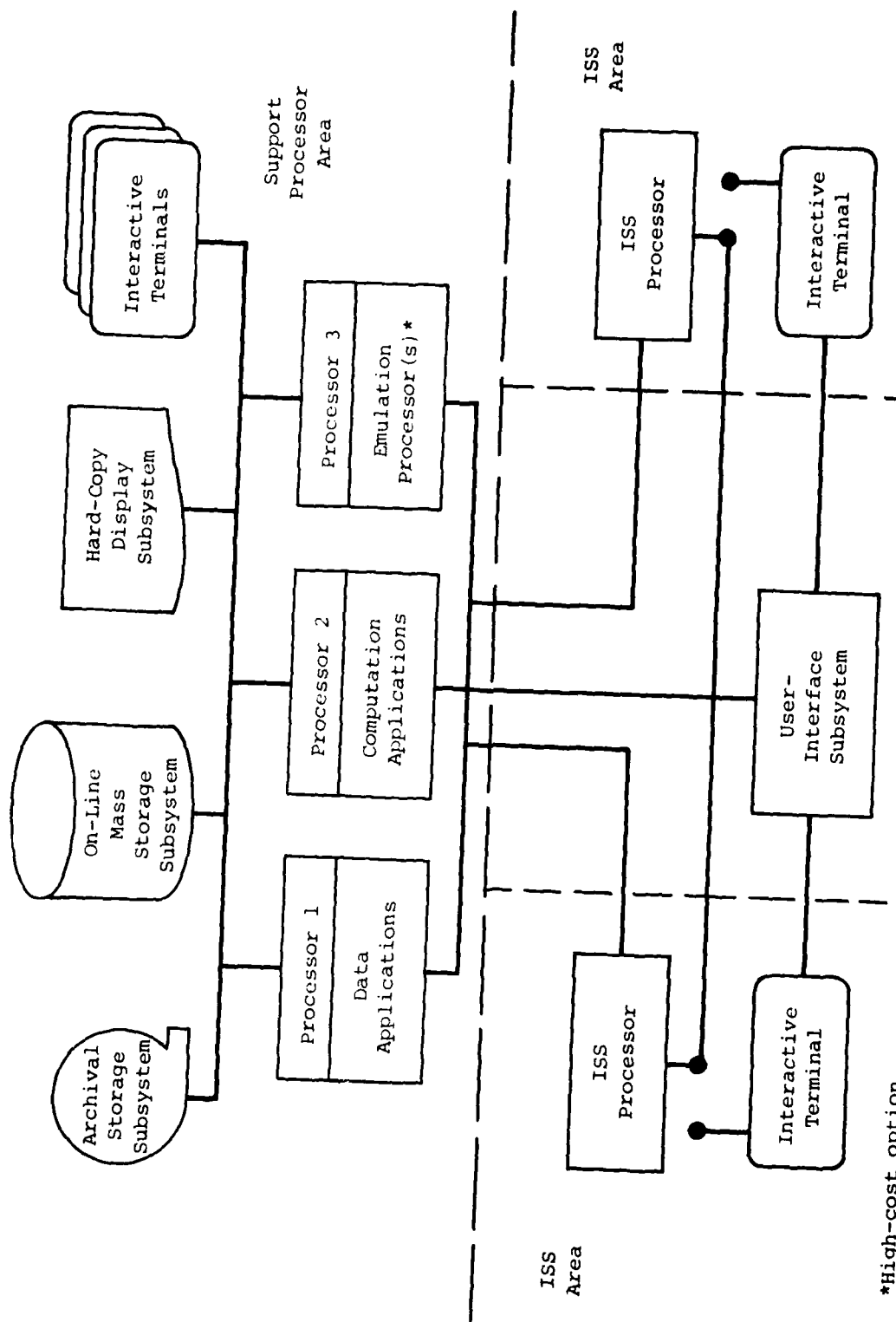


Figure 5-3. FRONT-END PROCESSOR ARCHITECTURE

instructions per second. Additional throughput capability is required in the high-cost option to provide the environmental simulation for the emulation processor. However, since the user terminals will be attached to the User Interface Subsystem, no terminal-handling capability is required. The data-handling machine must be capable of terminating medium-speed interfaces, 16 to the ISSs and 4 to the User Interface Subsystem. The scientific machine must be able to support a very high-speed interface to the emulation processor in the high-cost options. Each processor should be capable of attaching up to 20 disk drives as well as multiple-unit record devices. Table 5-2 listed representative computer systems capable of fulfilling these requirements.

In the high-cost option of the Front-End Processor Architecture, a microprogrammable emulation processor is required, which would have characteristics similar to the QM-1.

The User Interface Subsystem would employ four small processors to manage terminal interfaces, route tasks and data, and produce low-volume printed output. One processor would be located in the support processor area and the other three are on each floor. Each processor would be capable of terminating 12 terminals and 3 medium-speed interfaces. The processor must be capable of attaching a printer, at least one low-volume disk drive, and a tape or flexible disk drive. Table 5-3 is a representative list of computer systems with these characteristics.

Table 5-3. REPRESENTATIVE FRONT-END PROCESSORS			
Manufacturer	Model	Word Size (Bits)	Maximum Memory (Kbytes)
Data General	NOVA 3/12	16	64
	NOVA 3D	16	256
Digital Equipment Corporation	PDP 11/34	16	124
	PDP 11/35	16	124
Honeywell	Level 6/33	16	64
IBM	Series 1/4953	16	64
	Series 1/4955	16	256
Wang	VP/MVP	8	256
	VS	32	512

5.3.2.2 Peripherals

Peripheral requirements for the Front-End Processor Architecture are the same as for the Multiple-Processor Architecture, with the following exceptions:

- Three additional low- to medium-speed (400 to 600 lines per minute) line printers are required for the User Interface Subsystem.
- Four magnetic disk drives (5 to 10 Mbytes) are required for the User Interface Subsystem.
- Four low-volume storage devices (flexible disk or cassette tape) are required for system functions.
- A minimal computer operator interface is required for the User Interface Subsystem processors.
- Interactive terminals in place at the ISSs will be used for all functions, thereby significantly reducing the terminal requirements.

5.3.2.3 Communications

Data communications for the Front-End Processor Architecture are essentially the same as for the Multiple-Processor Architecture, with the following exceptions:

- The interactive terminals will be terminated at the User Interface Subsystem processors.
- Additional, medium-speed interfaces will be required between the ISS processors and the User Interface Subsystem processors.
- Medium-speed interfaces will be required between the User Interface Subsystem processor and the central processor scientific and data-handling machines.

Communications with external systems will be off-line via magnetic tape. The system will operate internally to a single restricted area, and secure encrypted communications will not be required.

5.3.2.4 Software

Chapter Four described the software required to implement the validated functions. Operating systems for processors of the types identified in Table 5-3 vary significantly in terms of features and support. An executive routine will be required to manage the User Interface Subsystem functions. The routing and task management software residing on the data-handling and scientific processors will migrate to the User Interface Subsystem processors.

5.4 SUMMARY

The three architectures to be evaluated in Phase 4, Cost-Benefit Analysis, are the Single-Processor Architecture, Multiple-Processor

Architecture, and Front-End Processor Architecture. These architectures offer three distinct modes of providing the EWAISF support processor functions.

CHAPTER SIX

COST-BENEFIT ANALYSIS

Previous chapters have defined the requirements and presented alternative architectures for the EWAISF support processor. This chapter presents estimates of costs and benefits for the previously defined architectures.

6.1 METHODOLOGY

The methodology consists of two parts: One part deals with estimated costs, while the other addresses system benefits in terms of the relative performance of the three alternative architectures.

Estimating costs is a relatively straightforward summation of expected costs for each architecture. In each case, costs are presented for development, investment, and operation for an assumed 10-year operating life.

As a surrogate for benefits, system performance is estimated for each architecture using a common workload. Performance estimation is derived from a dynamic simulation model developed for this study. The performance simulation model generates a job stream and then "dispatches" each job through the simulated architecture on the basis of the job's requirements, the architecture's capability, and the prior presence of other jobs.

Estimates of both costs and benefits should be viewed as suggestive rather than definitive. That is, this analysis is intended to permit clear rankings among alternatives, without necessarily providing precise estimates of either cost or performance.

6.2 ARCHITECTURAL ALTERNATIVES

The three alternative architectures analyzed herein are those defined earlier in this report:

- Single mainframe processor
- Multiple processors
- Multiple processor with front-end processors

The essential elements of each of these architectures are shown in Figure 6-1. Also shown in the figure is the high-cost option for each architecture, in which an additional emulation processor has been added to each architecture for special EW applications. The additional processor serves as an EW system computer emulator, while the mainframe processor, or one of the multiple processors, simulates the EW system's environment in near real time.

The basic distinction between the single mainframe option and the multiple-processor option is the separation of CPU power and workload into parallel job streams in the multiple-processor case. Generally, jobs for the EWAISF support processor can be characterized as emphasizing either computation or data management. Emulator jobs are characterized as an especially intensive computation application.

The main distinction between the basic multiple-processor option and the front-end processor plus multiple-processor option is that the front-end processor acts as a dispatcher to the support processor and also provides an interface between terminals and ISS processors.

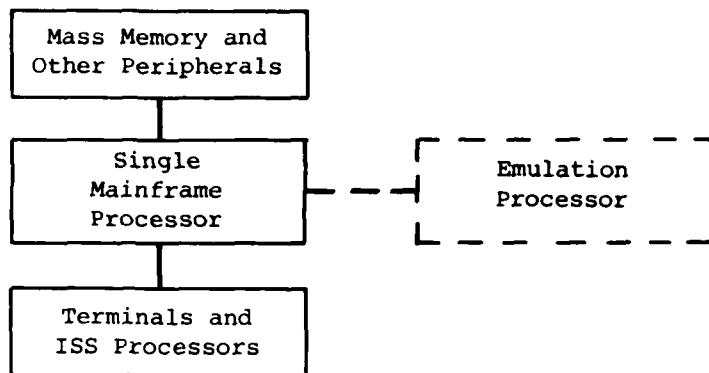
6.3 COST ESTIMATION

Cost estimation for each architecture is relatively straightforward. However, difficulties arise when we attempt to derive and justify particular estimates of individual cost components.

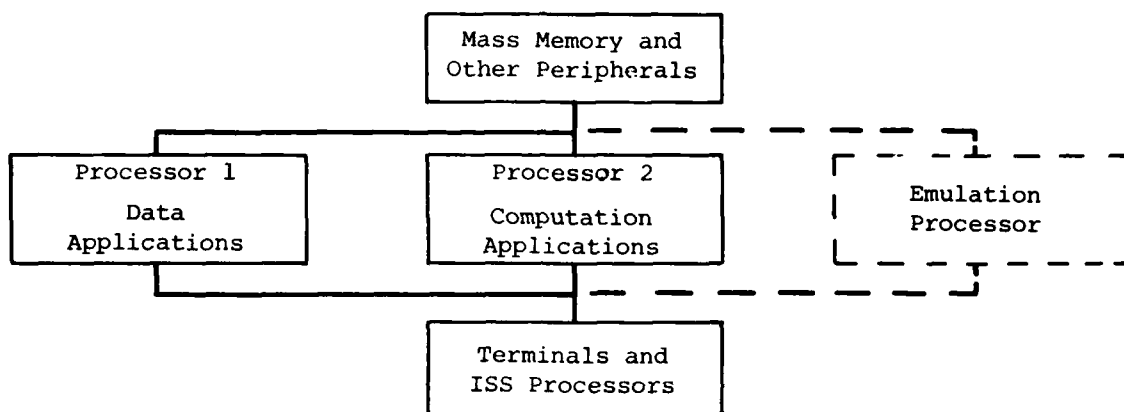
These cost estimates are not intended to serve as a detailed fiscal blueprint for system acquisition. Their purpose is to represent the typical cost consequences of each EWAISF support-processor option. The intent is to array the relative costs of each option with as much precision as is possible at this early stage. Thus, these cost estimates, together with the accompanying performance estimates, can indicate which option is preferable. Final cost estimates await specific decisions on such elements as equipment and staffing. The current estimates are based on apparently reasonable alternatives of implementing the three architectures.

There are three basic categories of cost elements: development, investment, and operation and maintenance. Development includes system design, hardware and software development, and any necessary integration and testing. Investment includes the cost of facilities to house the system; the actual equipment that constitutes the system; working inventory of supplies; and auxiliary charges for freight, installation, and initial training. Operation and maintenance include the cost of labor, materials, maintenance, and support services required to operate and use the system.

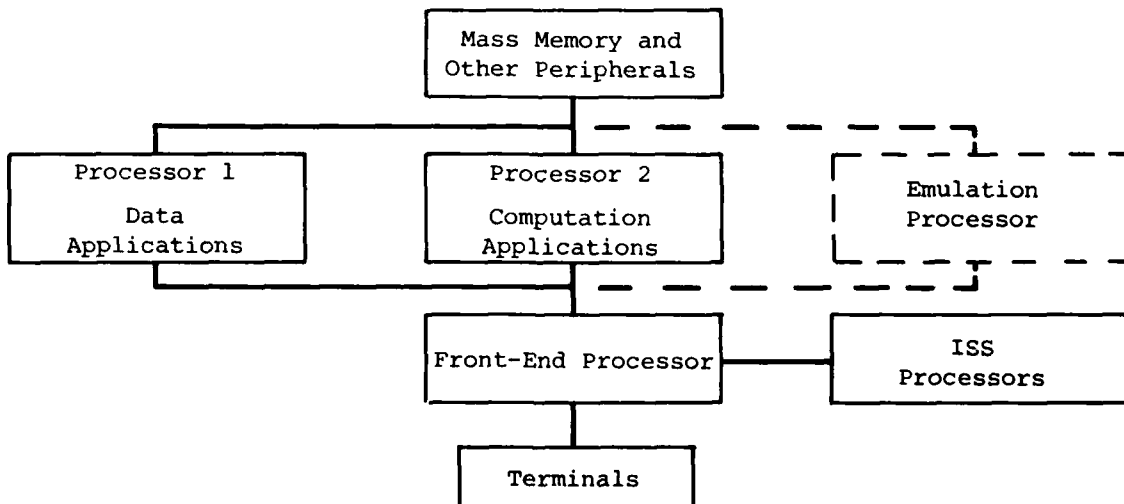
Discussions with cognizant personnel reveal that several of these cost elements can be regarded as already sunk and essentially invariant with respect to the three options. These costs include buildings and land, working inventory, materials, utilities, and support services. The following sections present the individual cost elements; the resulting costs are presented in Section 6.3.4.



(a) Single Mainframe Architecture



(b) Multiple-Processor Architecture



(c) Multiple Processors with Front-End Processor

Figure 6-1. ALTERNATIVE ARCHITECTURES FOR EWAISF HOST PROCESSOR

6.3.1 Development

6.3.1.1 System Design

This report constitutes an initial phase of system design in that requirements are defined, alternative architectures derived, and comparative cost and performance estimates developed. Study results should allow selection of a single system architecture to be pursued in detail for the remainder of the system design effort, which would involve detailed sizing, specification of performance characteristics, verification and validation of design, procurement preparation, and source selection. Performing these tasks will probably involve effort comparable to the initial definition and screening embodied in this report. Therefore, the cost element of system design is tentatively estimated at \$250,000, regardless of the architecture chosen, and is considered to take one year.

6.3.1.2 Software Development

It is believed that system hardware for any of the alternatives can be procured off-the-shelf. Thus no hardware development costs are foreseen. However, substantial software development costs are expected for the three architectures. These development costs consist of rehosting, new development, and growth requirements and would be approximately the same for each architecture. The extent of these requirements is outlined in Table 6-1.

In the overall system timetable postulated for the cost-benefit analysis, it is believed that both rehosting and new software development will occur during that year in which equipment is procured, while the growth requirement will be met annually over the next 10 years. In all cases, rehosting, development, and growth are assumed to be performed by technical personnel comparable to a GS-12 rating.

This workload implies an initial force of approximately 60 man-years to rehost and develop the new software in the first year after procurement, with a subsequent reduction to 17 man-years per year during the 10-year operating life of the system. For comparative costing, the additional 43 man-years during the installation year are assumed to be obtained at a cost approximating the 1981 salary of GS-12 personnel. (Composite pay rates for personnel are shown in Appendix C.)

6.3.2 Investment

Equipment cost estimates were obtained from a representative vendor. The vendor was provided with the system block diagrams and summary specifications outlined in Chapter Five and asked to submit a turnkey quotation for each architecture. These costs are presented in Appendix D.

Depending upon competitive forces prevailing at the time of procurement and upon more detailed specifications normally provided for an actual procurement, actual quotations might differ from the informal quotations of Appendix D. However, for preliminary screening, the estimates are representative of the previously defined architectures, because the vendor has no known or detectable bias in developing blind quotations.

Table 6-1. SOFTWARE DEVELOPMENT RESOURCES FOR THE EWAISF SUPPORT PROCESSOR			
Cost Element	Lines of Code (LOC)	Man-Hours	Man-Years at 1,920 Man-Hours/Man-Year
Software Rehosting* (Existing Software)	158,900	52,967	27.59
Subtotal	158,900	52,967	27.59
New Software Development**			
Automatic Software Documentation	3,000	3,000	1.56
Data Reduction/Analysis	3,000	3,000	1.56
V&V Test Support	10,000	10,000	5.21
Change Distribution	500	500	0.26
Data Table Generation	500	500	0.26
ISS Configuration Management	3,000	3,000	1.56
Training	10,000	10,000	5.21
Program Support Library	10,000†	--	--
Project Control	10,000†	--	--
Configuration Management	3,000	3,000	1.56
Document Control	500	500	0.26
On-Line Simulation	10,000	10,000	5.21
V&V Tracking	500	500	0.26
System Modeling	10,000	10,000	5.21
Budget Cycle Preparation	3,000	3,000	1.56
Life-Cycle-Cost Analysis	3,000	3,000	1.56
Procurement Preparation	3,000	3,000	1.56
Checkbook Maintenance	500	500	0.26
Subtotal	83,500	63,500	33.06
Total	242,400	--	60.65
Growth Requirement (10% per year) = 242,400 LOC $\times (1.1)^{N-1}$, N = 10 = 571,566 LOC [-242,400 at t ₀] = 329,116 LOC growth at 8 LOC/day = 171 man-years	329,116	329,116	171.0
*Developed at 24 LOC/day (including supporting data bases). **Developed at 8 LOC/day. †Commercially acquired.			

6.3.3 Operation

6.3.3.1 Labor

Labor cost estimates are predicated upon the staffing as shown in Table 6-2. Four categories of staffing are envisioned for operation of the EWAISF support processor: management, operation, software development,

Table 6-2. STAFFING REQUIREMENTS FOR EWAISF SUPPORT PROCESSOR		
Function	Grade	Number of Personnel*
Management		
Manager	GS-14	1
Supervisor	GS-13	1
Supervisor	GS-12	1
Secretary	GS-3/4	3
Software Development		
Software Developer	GS-12	17
Operation		
Data Base Administration	GS-11	1
System Maintenance	GS-12	5
Librarian	GS-9	2
Shift Supervisor	GS-9	2
Computer Operator	GS-7	4
Clerical (Entry)	GS-5	4
Clerical (Output)	GS-5	2
EW Support**		
EW Support Personnel	GS-12	16 people at 1/2 time
*Based on two-shift operation. **Not required for multiple processor with front- end processors.		

and EW ISS support. For the cost-benefit analysis, the software development labor is recorded under system development, described in Section 6.3.1.2, while management, operation, and EW ISS support are recorded under operations. In all cases, estimated costs are obtained by multiplying the estimated required labor by the appropriate category costs presented in Appendix C.

6.3.3.2 Equipment Maintenance

Equipment maintenance estimates are quoted directly from the vendor (see Appendix D). Although these maintenance estimates are subject to the same variation as the equipment quotations upon which they are based, we believe they fairly represent the three alternative architectures.

6.3.4 Composite Life-Cycle-Cost Estimates

Given the detailed estimate of system component costs, summary life-cycle-cost profiles are presented in Tables 6-3, 6-4, and 6-5. In each of these tables, system design and installation and setup are assumed to require two years, and useful operating life is 10 years. As shown in Table 6-5, the multiple processor with front-end processors is the least costly option, with present-value life-cycle costs of \$10.2 million for the basic system and \$10.5 million for the high-cost option.

The multiple processor (Table 6-4) ranks second in life-cycle costs, with present-value life-cycle costs of \$11.4 million for the basic system and \$11.7 million for the high-cost option.

The single processor (Table 6-3) is the most costly option, with present-value life-cycle costs of \$12.1 million for the basic system and \$12.4 million for the high-cost option.

6.4 BENEFITS ESTIMATION

6.4.1 System Performance as System Benefit

System benefits are often defined and measured in monetary terms, such as cost savings or return-on-investment. However, in the case of the EWAISF support processor, there is no clear monetary measure of benefits. What is of concern is how well each architecture performs, what is its level of service, and how capable is the system in the face of workload surges. Therefore, it seems most appropriate to use system performance as the measure of benefit to be obtained.

6.4.2 Strategy for Estimating Performance

The problem of estimating the performance of hypothetical systems in treating a job stream that does not yet fully exist requires the following:

- Defining a job stream representative of the expected workload to be faced by the EWAISF support processor
- Defining basic performance capabilities for each architecture
- Presenting the same job stream to each architecture to estimate that architecture's response and relative quality of performance

Therefore, the basic strategy for estimating performance is to simulate the behavior of each architecture as it treats a representative job stream.

Table 6-3. LIFE-CYCLE-COST SUMMARY OF SINGLE MAINFRAME PROCESSOR FOR EMAISF SUPPORT PROCESSOR

Cost Element	Costs in Thousands of Dollars												
	Initial Development		10-Year Operating Life Cycle										Total
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	
Development													
System Design	250												250
Software Development		2,106	597	597	597	597	597	597	597	597	597	597	8,076
Investment													
Basic System		1,488											1,488
High-Cost Option		1,767											1,767
Operation													
Labor													
Basic System			923	923	923	923	923	923	923	923	923	923	9,230
Maintenance			124	124	124	124	124	124	124	124	124	124	1,240
High-Cost Option			141	141	141	141	141	141	141	141	141	141	1,410
Maintenance													
Total Annual Cost													
Basic System	250	3,594	1,644	1,644	1,644	1,644	1,644	1,644	1,644	1,644	1,644	1,644	20,284
High-Cost Option	250	3,873	1,661	1,661	1,661	1,661	1,661	1,661	1,661	1,661	1,661	1,661	20,733
Discounted Annual Cost*													
Basic System	239	3,116	1,295	1,179	1,072	973	884	804	732	666	605	549	12,114
High-Cost Option	239	3,358	1,309	1,191	1,083	983	894	812	739	673	611	555	12,447

Notes:

1. Present-value life-cycle cost of basic system = \$12,114
2. Present-value life-cycle cost of high-cost option = \$12,447

*The standard table from DODI 7041.3 (reproduced as Table C-2 in Appendix C) is used for discounting to obtain present values (at the beginning of Year 1).

Table 6-4. LIFE-CYCLE-COST SUMMARY OF MULTIPLE PROCESSORS FOR ENALSF SUPPORT PROCESSOR														
Cost Element	Costs in Thousands of Dollars													
	Initial Development		10-Year Operating Life Cycle											Total
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12		
Development	250													250
System Design														
Software Development														
Investment		2,106	597	597	597	597	597	597	597	597	597	597	597	8,076
Basic System		1,012												1,012
High-Cost Option		1,291												1,291
Operation														
Labor			923	923	923	923	923	923	923	923	923	923	923	9,230
Basic System			68	68	68	68	68	68	68	68	68	68	68	680
Maintenance														
High-Cost Option			84	84	84	84	84	84	84	84	84	84	84	840
Maintenance														
Total Annual Cost														
Basic System	250	3,118	1,588	1,588	1,588	1,588	1,588	1,588	1,588	1,588	1,588	1,588	1,588	19,248
High-Cost Option	250	3,397	1,604	1,604	1,604	1,604	1,604	1,604	1,604	1,604	1,604	1,604	1,604	19,687
Discounted Annual Cost*														
Basic System	239	2,703	1,251	1,139	1,035	940	854	777	707	643	584	530	530	11,402
High-Cost Option	239	2,945	1,264	1,150	1,046	950	863	784	714	650	590	536	536	11,731
Notes:														
1. Present-value life-cycle-cost of basic system = \$11,402														
2. Present-value of life-cycle-cost high-cost option = \$11,731														
*The standard table from DODI 7041.3 (reproduced as Table C-2 in Appendix C) is used for discounting to obtain present values (at the beginning of Year 1).														

Notes:

1. Present-value life-cycle-cost of basic system = \$11,402
2. Present-value of life-cycle-cost high-cost option = \$11,731

*The standard table from DODI 7041.3 (reproduced as Table C-2 in Appendix C) is used for discounting to obtain present values (at the beginning of Year 1).

Table 6-5. LIFE-CYCLE-COST SUMMARY OF MULTIPLE PROCESSOR WITH FRONT-END PROCESSORS FOR EWAISF SUPPORT PROCESSOR													
Costs in Thousands of Dollars													
Cost Element	Initial Development		10-Year Operating Life Cycle										Total
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	
Development	250												250
System Design													
Software Development													
Investment		2,106	597	597	597	597	597	597	597	597	597	597	8,076
Basic System		1,259											1,259
High-Cost Option		1,538											1,538
Operation													
Labor			642	642	642	642	642	642	642	642	642	642	6,420
Basic System			87	87	87	87	87	87	87	87	87	87	870
Maintenance													
High-Cost Option			103	103	103	103	103	103	103	103	103	103	1,030
Maintenance													
Total Annual Cost													
Basic System	250	3,365	1,326	1,326	1,326	1,326	1,326	1,326	1,326	1,326	1,326	1,326	16,875
High-Cost Option	250	3,644	1,342	1,342	1,342	1,342	1,342	1,342	1,342	1,342	1,342	1,342	17,314
Discounted Annual Cost*													
Basic System	239	2,917	1,045	951	865	785	713	648	590	537	488	443	10,221
High-Cost Option	239	3,159	1,057	962	875	794	722	656	597	544	494	448	10,547

Notes:

1. Present-value life-cycle cost of basic system = \$10,221
2. Present-value life-cycle cost of high-cost option = \$10,547

*The standard table from DODI 7041.3 (reproduced as Table C-2 in Appendix C) is used for discounting to obtain present values (at the beginning of Year 1).

6.4.2.1 Defining the Job Stream

It was initially believed that historical logs of the existing system would make possible direct definition of a representative job stream for the new EWAISF support processor. However, two difficulties were encountered:

- It proved impossible to derive detailed job characteristics from the summary data contained in the system archives.
- It is unlikely that the historical workload fairly represents the workload that will confront the new EWAISF support processor, since current workloads usually represent user adjustment to current systems. Such matters as job size, timing of job submission, and the decision of whether to submit the job at all customarily reflect the expected quality of service.

Therefore, the use of historical data would amount to testing the ability of the new architectures to cope with a job stream that has adjusted itself to the existing architecture. A job stream is required that does not reflect the influence of this adjustment.

It was thus decided to generate a job stream consistent with and based on the requirements analysis phase of this study. The typical or average job defined in Chapter Four was characterized by the following:

- 5,000 instructions
- 25 iterations
- 0.5 of the instructions executed per iteration
- An executive overhead of 0.25 of the program's instructions
- A data storage requirement in main memory 10 times the size of the program containing the 5,000 instructions

From these characteristics, a hypothetical job stream was generated by allowing each job parameter to vary randomly. The random variation was of the "minimum information" kind, in that each job parameter for each job was presumed to be drawn from a uniform (or rectangular) probability distribution. In this case, the minimum-information assumption means that the maximum value of each parameter is twice the mean, which gives the following range for job parameters:

- 1,000 to 10,000 instructions
- 1 to 50 iterations
- 0.1 to 1.0 of the instructions executed per iteration
- 0.0 to 0.5 executive instruction overhead
- 1 to 20 as a ratio of data to program storage bytes

For the special case of emulation runs, the following parameters were assumed:

- 10,000 instructions
- 1,000 iterations
- 0.5 executive instruction overhead
- 20,000 data bytes

Exerciseing the variability of these job parameters produces run parameters with the following ranges:

- 1,000 to 750,000 executed instructions
- 4,000 to 420,000 bytes of main memory
- 4,000 to 40,000,000 bytes of I-O transfer

6.4.2.2 Defining System Capabilities

The translation of run parameters into run times requires specifying the performance capabilities of each architecture. Three important system parameters should be specified:

- Instruction execution rate of CPU
- Capacity of main memory
- I-O transfer rate between mass memory and CPU

On the basis of the system sizing accomplished during the requirements analysis, the performance capabilities of the different architectures were developed. The Single-Processor Architecture required the following:

- 500,000 instructions per second execution rate
- 1.25 megabytes of main memory
- 1.5 megabytes per second I-O. This is the rate at which the system can search for, recover, and transmit data from mass memory to the CPU.

For the multiple-processor option, these capabilities were partitioned between the data applications processor and the computation applications processor. The data applications processor was characterized by the following:

- 250,000 instructions per second execution rate
- 0.625 megabytes of main memory
- 1.0 megabytes per second I-O

1

The computation applications processor was characterized by the following:

- 250,000 instructions per second execution rate
- 0.625 megabytes of main memory
- 0.5 megabytes per second I-O

For the Multiple-Processor Architecture, the partitioning of execution rate and main memory was uniform between the computation and data applications processors. However, the data applications processor was allocated twice the I-O capability of the computation processor, on the basis that data-intensive work would be passing more data back and forth between the processor and mass memory.

This allocation of capabilities is reasonable but not necessarily optimal. Optimal allocation involves questions of detailed design, hardware selection, and polling procedures. The present intent is merely to define typical capabilities and to estimate the resulting performances as they relate to one another.

6.4.2.3 Performance Simulation

In summary, performance simulation of the proposed EWAISF architectures requires the series of steps indicated below (these steps are defined in more detail in Appendix E):

- Develop functional descriptions of each architecture. It is apparent that the crucial parameters are the instruction execution rate measured in thousands of executed instructions per second (kips) and input-output rate of data transfer between mass memory and CPU measured in kilobytes per second (kbps). It is also true that the model makes no functional distinction (in terms of this simulation) between the multiple-processor option and the multiple processor with front-end processors. This is because the dispatch function occurs in both options, and the model does not differentiate between which processor acts as the dispatcher. For an intensively used communication net, this distinction could prove crucial. However, for reasonable job-arrival rates for the EWAISF support processor, the performance distinction appears to be trivial. The major difference between these options lies in cost differences generated by different staffing requirements.
- Generate a baseline job stream. Each job is described by number of instructions, number of iterations, number of instructions per iteration, executive instruction overhead, and data-to-instruction byte ratio. As described above, each job's parameter is randomly drawn from a rectangular distribution, whose mean is the agreed-upon value identified during the requirements analysis.

- Translate job parameters into run parameters. This is accomplished by using the following equations:
 - Executed instructions = (number of instructions) × (number of iterations) × (proportion of instructions per iteration) × (1.0 plus executive instruction ratio)
 - I-O bytes transfer = (number of instructions) × (2 bytes per instruction) × (ratio of data bytes per instruction bytes) × (number of iterations) × 2 [assuming one retrieval and one storage per iteration]
- Combine run parameters and architectural capabilities to define run times for each job for each architecture. This requires assigning each job to the appropriate processor, computing I-O and execution times, and then combining I-O and execution times to yield a system turnaround time excluding waiting time.
- Present the baseline job stream to each architecture at varying arrival rates. The mean arrival rates used in this simulation are 75, 150, 300, and 600 jobs per hour. These arrival rates were chosen as representative of an EWAISF support processor supporting 16 EW systems and diverse management queries. These overall arrival rates imply mean interarrival times of 48, 24, 12, and 6 seconds. Following the minimum-information convention of generating job characteristics, these interarrival times are simulated by drawing from rectangular probability distributions ranging from 0 to 96 seconds, 0 to 48 seconds, 0 to 24 seconds, and 0 to 12 seconds.

As a simulation convention, one second is treated as an interval of time in which system-processing events occur. A job arriving at the system is presumed to arrive at the beginning of a simulated second and to leave, thereby releasing system capability, at the end of the second in which processing is terminated.

6.4.3 Comparative Simulation Results

Table 6-6 summarizes simulations of the Single Mainframe and Multiple-Processor Architectures. As in the cost-estimate case, it should be stressed that these simulation results can be viewed only as indicators of relative performance; they are not intended to predict actual experience.

The following major conclusions resulted from these simulations:

- Over a reasonable range of activity, all of the system architectures appear to be adequate.
- As the rate of job submissions increases, the multiple-processor option appears to be more capable. All alternatives degrade with high input rates, but the multiple-processor alternatives degrade more gracefully, i.e., more timely recovery from queues created by unscheduled downtime.

Table 6-6. COMPARATIVE DELAYS FOR COMPUTATION AND DATA APPLICATIONS RUNS FOR THE SINGLE-PROCESSOR AND MULTIPLE-PROCESSOR ARCHITECTURES FOR VARYING JOB-ARRIVAL RATES						
Composite Job Arrival Rate	Average Delay per Job (In Seconds)					
	Computation Applications		Data Applications		Composite of All Jobs	
	Single Processor	Multiple Processor	Single Processor	Multiple Processor	Single Processor	Multiple Processor
75 per hour	2.0	4.1	3.0	1.4	2.4	2.8
150 per hour	2.1	5.7	5.1	3.8	3.5	4.8
300 per hour	21.8	32.9	25.4	9.4	23.5	21.9
600 per hour	112.6	66.9	100.4	63.0	106.8	65.1

This assessment of system costs and benefits suggests that all three architectures are viable candidates for the EWAISF support processor. Neither estimated costs nor performance simulations reveal great disparities among the different alternatives.

Sufficient differences do exist, however, to establish a preference ranking among the alternatives. On this basis, the multiple processor with front-end processors would be the first preference. This option is the least expensive and performs almost as well as the single processor for light workloads and significantly better for heavy workloads. In addition, this option (as well as the basic multiple-processor option) is more capable than the single processor in coping with heavy workloads or in dealing with long queues resulting from unscheduled outages.

The Multiple-Processor Architecture is the second preference. This alternative performs comparably to the multiple processor with front-end processors' architecture with respect to simulation performance. This alternative does involve higher operating costs, which offsets the slightly higher initial investment for the front-end processor.

The Single-Processor Architecture is the third preference. Although apparently adequate for EWAISF support processor requirements, this alternative is the most expensive of the three and apparently the least capable in dealing with heavy workloads or downtime recovery.

CHAPTER SEVEN

RECOMMENDATIONS FOR IMPLEMENTING THE PREFERRED ALTERNATIVE

As indicated in Chapter Six, the multiple processor with front-end processors is the preferred alternative. This chapter presents a recommended approach to the orderly implementation of the preferred alternative. This approach takes into consideration the existing data-handling and computational facilities of the EWASIF, as well as planned near-term acquisitions. It also considers the desire of MMR to implement a more responsive support capability as soon as possible.

7.1 OVERVIEW OF APPROACH

The recommended approach would implement the Front-End Processor Architecture in the 1985 time period. To provide an interim capability and to evolve expertise with networked architectures, the Multiple-Processor Architecture is implemented in the near term as a transitional capability. This implementation makes maximum use of existing resources. However, the approach is predicated upon an orderly development cycle that will minimize the potential negative impact on mission-essential operation during the implementation.

The approach would be accomplished in four phases, as follows:

- Phase 1: Multiple-Processor Prototype Development
- Phase 2: Initial Operation
- Phase 3: Front-End Processor Prototype Development
- Phase 4: Front-End Processor Operation

To the greatest extent possible, each phase will utilize the equipments and software of the previous phases. The phases are defined in detail in the following sections.

7.1.1 Phase 1: Multiple-Processor Prototype Development

The purpose of Phase 1 is to implement and test a support capability that would be available in the near term. The Multiple-Processor Architecture is chosen for this transitional phase because it is somewhat less complex to implement and requires less augmentation of existing resources than

the Front-End Processor Architecture. This phase would be accomplished by implementing a prototype Multiple-Processor Architecture using an augmented capability to be provided on the EWOLS and ECSAS VAX 11/780 processors. On the basis of the capabilities of the DECnet network processing architecture, these machines would be logically divided into EWOLS and ECSAS and computation and data-handling systems. Figure 7-1 shows the logical division of these resources. The prototype would then operate on only two processors in a "loop back" mode; i.e., there would be four logical processors but only two physical processors. Software development would occur during normal prime-shift hours, but testing and operation would be performed on a noninterference basis with mission operations of EWOLS and ECSAS.

During this phase, some equipment augmentation would be required, including the addition of interprocessor links between the EWOLS and ECSAS processors and the addition of shared disk storage capacity between the systems. For the prototype development, no change in attached terminal assets would be required.

The prototype phase would require the development of the initial control software for the ISS processors and for the support processors, i.e., the dispatcher software. This software would form the basis for the next phase -- Initial Operations. The dispatcher software, with minor modifications, should be capable of continued use throughout the subsequent phases.

The steps necessary to accomplish Phase 1 are as follows:

- Acquire and install network links and software (DECnet)
- Design multiple-processor dispatcher software
- Design ISS dispatcher software
- Review and prioritize applications software
- Rehost critical software
- Design new functions
- Specify and acquire data base management system (DBMS)
- Specify and acquire document processor
- Implement dispatcher software (support and ISS)
- Convert critical data bases
- Test and evaluate prototype

The early identification of critical software and data bases for conversion is imperative to provide an operational capability as soon as possible. In addition, the volume of EW system documentation residing and being maintained on the current support processor necessitates an early start on its conversion. It is recommended that only existing functions be implemented during this phase. First, this will permit more rapid

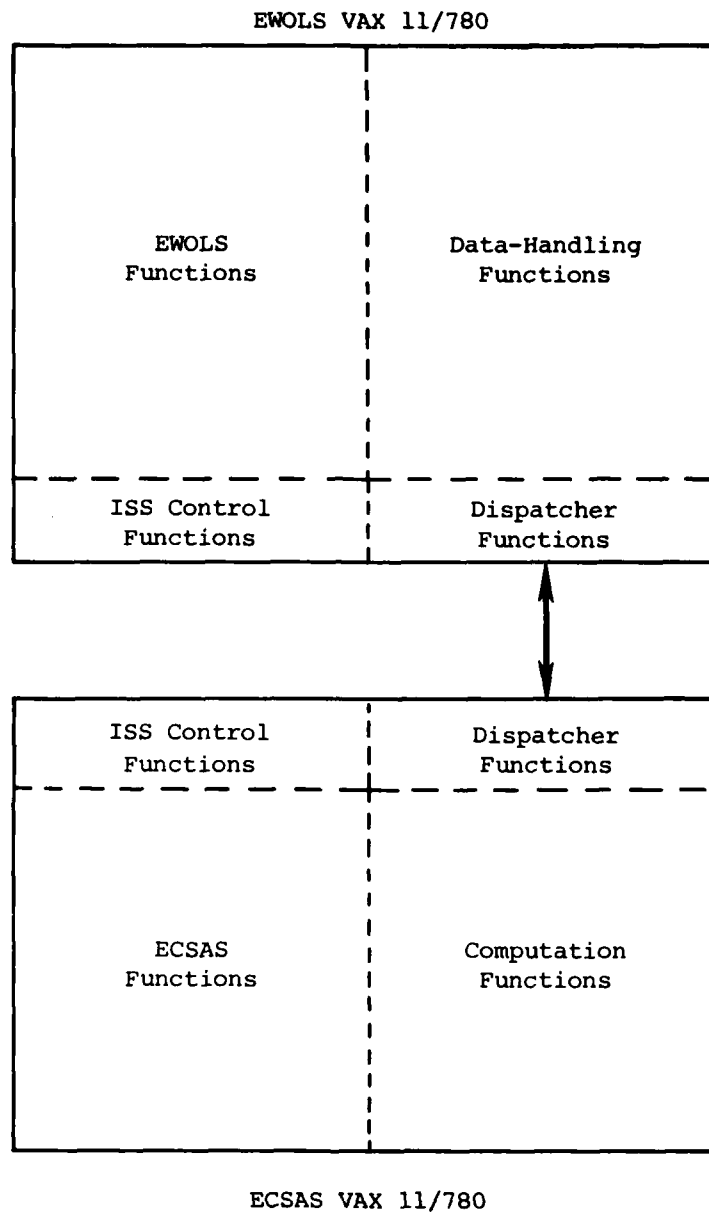


Figure 7-1. LOGICAL DIVISION OF
SYSTEM RESOURCES

initiation of support operations. Second, the experience gained during this phase will provide for more effective design of new applications.

Finally, this phase provides for a structured test phase. This phase would begin with nonprime shift testing on a noninterference basis. This

would include debug and initial integration testing. It would then evolve into an operational test in which the processors would perform EWOLS, ECSAS, and support processor functions concurrently. This latter testing is crucial to the initiation of the operation of the Multiple-Processor Architecture in the EWAISF. The initiation of operations without this structured test phase could jeopardize ISS mission support operations, because of an increased probability of a support processor failure. Efforts would begin prior to completion of Phase 1 test and evaluation; however, additional ISSs would not be brought on-line until test and evaluation was complete.

7.1.2 Phase 2: Initial Operation

During Phase 2, the ISS processors would be brought on-line to the support processors (implemented on the EWOLS and ECSAS processors). The remaining existing software would be rehosted, and the new applications designed in Phase 1 would be implemented. This phase would result in a cutover from the existing U1108 support processor to the Multiple-Processor Architecture. During this phase, user training would occur, and operational test and evaluation of the support processor would be accomplished. The steps necessary for this phase are as follows:

- Attach ISS processors
- Install ISS dispatcher software
- Implement new applications software
- Convert remaining existing applications software
- Convert remaining data bases
- Convert system documentation
- Train users
- Cut over from U1108
- Test and evaluate multiple-processor operations

At the end of Phase 2 all operations would be resident on the new support processor, and the U1108 could be removed. Actually, the U1108 could be removed prior to the end of this phase; however, early elimination of the U1108 would result in disruption of some existing capabilities and could negatively affect data base and system documentation conversion.

7.1.3 Phase 3: Front-End Processor Prototype Development

During Phase 3, a prototype would be implemented for the Front-End Processor (FEP) Architecture. An architecturally compatible ISS processor would be selected for use as a prototype. This processor would be linked to the support processor in nonprime time on a noninterference basis. The executive software performing the user interface would be implemented on the ISS processor. Modification to the ISS and support processor dispatcher software would be implemented as required. (It is anticipated that many of the changes required could be implemented readily by changing the definition

of the DECnet network). The selected processor would be brought on-line to the support processor, and a test and evaluation would be performed. The steps required to accomplish this phase are as follows:

- Identify noncompatible ISS architectures
- Select FEP prototype processor
- Design FEP software
- Design dispatcher software modifications
- Implement FEP and dispatcher software
- Attach FEP prototype processor to support processor
- Test and evaluate FEP operations
- Analyze ISS operating systems
- Develop special FEPs as required

As result of the test and evaluation activity, sufficient experience will be gained to ensure that all ISS processors with compatible architectures can be equalized in terms of operating systems support. In those cases in which specialized operating systems or noncompatible architectures are necessary, FEP software would be tailored for that ISS.

7.1.4 Phase 4: Front-End Processor Operation

In Phase 4 the preferred alternative, described in Chapter Six, would be implemented and would consist of the following steps:

- Install FEP software on ISSs
- Convert ISS and support processor dispatcher software as required
- Perform user training
- Cut over from multiple-processor operation

The installation and training process would be accomplished on a one-system-at-a-time basis during nonprime shift hours. Once installation and training were complete, the cutover would occur for all ISSs concurrently.

7.2 SCHEDULE

The recommended schedule for implementing the described approach is shown in Figure 7-2. This schedule provides some capability in early to mid-1983 and the complete initial operating capability at the end of 1983. Full-system capability would occur in mid- to late 1985. This schedule is predicated upon the personnel staffing and development resource estimates defined in Chapter Six. It provides for an orderly, controlled implementation of the support processor capabilities. On the basis of these resource estimates, any reduction in the schedule would require attendant additional resources or a reduction in support processor capabilities.

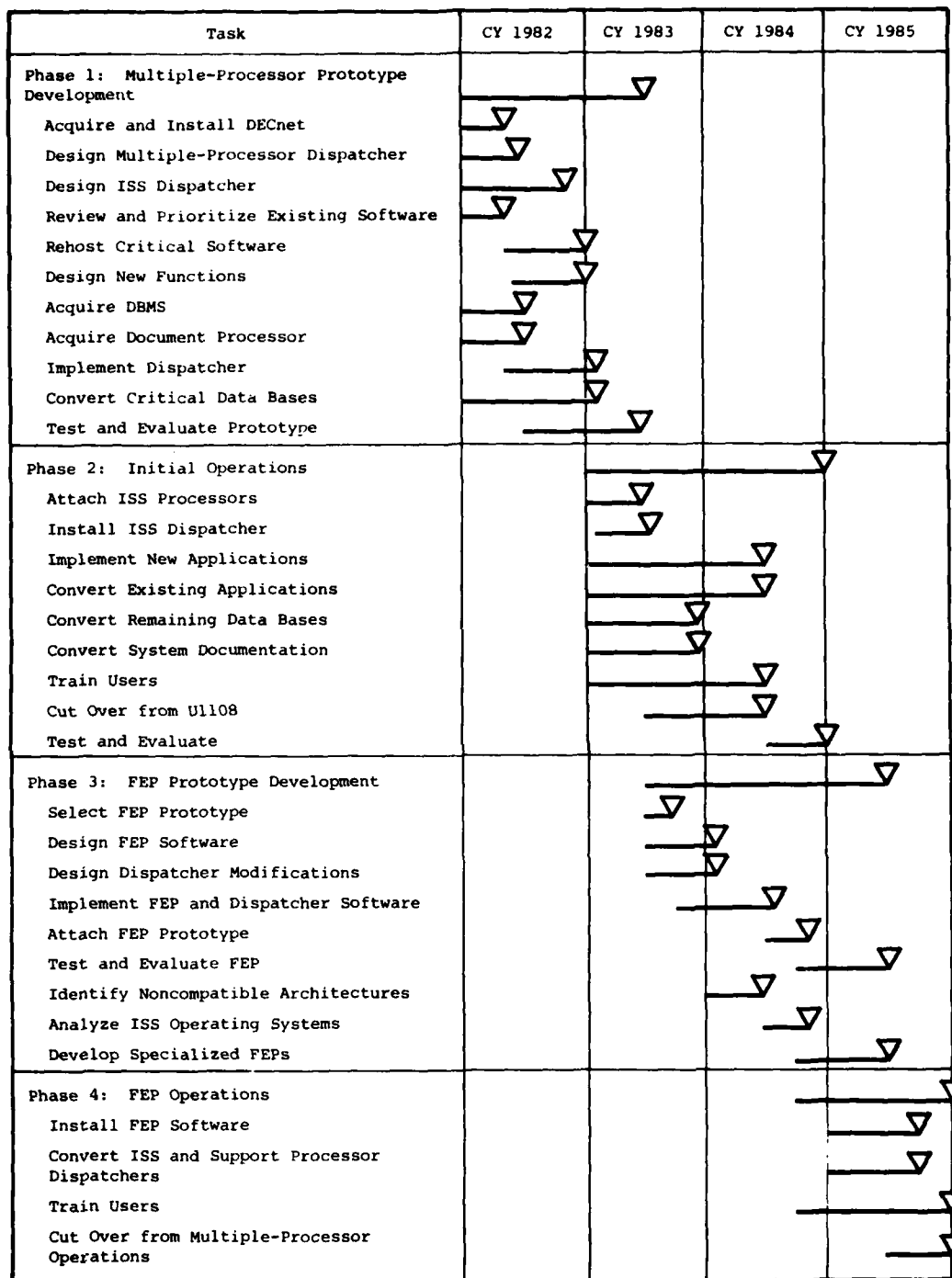


Figure 7-2. RECOMMENDED IMPLEMENTATION SCHEDULE

7.3 OTHER CONSIDERATIONS

It may become necessary to update the study described in this report. Circumstances that could require an update include new support concepts or support of new EW systems. A recommended approach has been prepared for accomplishing an update if it is required. This approach is described in Appendix F.

APPENDIX A

USER REQUIREMENTS DEFINITION

This appendix presents the results of the initial user surveys conducted in November and December 1980. A specification sheet was prepared for each requirement identified by an interviewee.

The specification sheet provides a means for recording descriptive information, performance requirements, and operational considerations for each identified requirement. For the preliminary survey, no attempt was made to "level" the specifications, i.e., interviewee's requirements were not interpreted on the basis of information from another interviewee. The "leveling" process occurred during Phase 2, Requirements Analysis. The specifications are presented in the chronological sequence of the interviews.

The specification forms show the requirements anticipated by support processor users for 1985 and beyond. Some of these requirements are currently supported by the UNIVAC U1108 system but others are not. For some, the support requirements change from the present to the study time frame. The form is divided into three general fields: descriptive information, current ADP support, and projected requirements for 1985 and beyond.

The information necessary for this phase of the analysis consisted of the descriptive information to be provided in the upper portion of the form and the software/functions portions of the current support and projected requirements sections. Where additional information was supplied by the respondents, it has been indicated; otherwise, the areas not required have been left blank.

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function:	System:	Projected Life:	User/Contact:
Documentation Maintenance	EF-111 TJS	Duration of EF-111 Life	WERRIC/Hal Maney
Description of Function: A capability to enter, edit, and produce system documentation is required. This will include the capability to insert, delete, modify, tabulate, paginate, search the text, and provide headers and footings.		Frequency of Function: This is an ad hoc function that occurs when software is changed.	
Current Support		Projected Requirements	
ADPE Resources	Software Functions	ADPE Resources	Software Functions
Processor: U1108 Storage: Print: Terminal: Memory: Processing: Other Systems:	• Text Editor • Document Processor	Processor: Support Processor Storage: Print: Terminal: Memory: Processing: Other Systems:	• Text Editor • Document Processor
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function: Assembly	System: EF-111 TJS	Projected Life: Upon replacement of IBM 4PI for duration of system life	User/Contact: MERRIC/Hal Maney	4 Nov 80
Description of Function: An assembly capability will be required for the AN/AYK-14 processor. (Dependent on decision to replace IBM 4PI.)		Frequency of Function: This ad hoc engineering support for software assembly is used during change processing.		
Current Support		Projected Requirements		
ADPE Resources	Software Functions	ADPE Resources*	Software Functions	
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems: VAX 11/780 DECI interface to AN/AYK-14	• Program File Maintenance • AN/AYK-14K Assembly • Translation, 4PI to AN/AYK-14	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

*Prime support is provided by VAX 11/780. Support processor can be used as back-up only if it is compatible with VAX 11/780.

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: Assembly	System: EF-111 TJS	Projected Life: Until 4Pi Processor is replaced	User/Contact: MERRIC/Hal Maney 4 Nov 80
Description of Function: An assembly capability is required for the IBM 4Pi processor.		Frequency of Function: This ad hoc engineering support for software assembly is used during the software change process (scheduled or emergency).	
Current Support		Projected Requirements	
ADPE Resources Processor: U1108 Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • Program File Maintenance • IBM 4Pi Assembly • Program Tape Generation	ADPE Resources* Processor: Storage: Print: Terminal: Memory: Processing: Other Systems: VAX 11/780 DECI for interface to IBM 4Pi	Software Functions • Program File Maintenance • IBM 4Pi Assembly
Personnel Resources	Constraints or Limitations • Assembler too slow. To be rehoted on VAX 11/780.	Personnel Resources	Constraints or Limitations

*Prime support is provided by VAX 11/780. Support processor can be used as back-up only if it is compatible with VAX 11/780.

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function: Assembly	System: EF-111 TJS	Projected Life: Until replacement of Litton LC-4516	User/Contact: MERRIC/Hal Maney	4 Nov 80
Description of Function: An assembly capability is required for Litton LC-4516 software.		Frequency of Function: This ad hoc engineering support for software assembly is used during the software change process (scheduled or emergency).		
Current Support		Projected Requirements		
ADPE Resources	Software Functions	ADPE Resources*	Software Functions	
Processor: U1108 Storage: Print: Terminal: Memory: Processing: Other Systems:	<ul style="list-style-type: none"> • Program File Maintenance • Litton LC-4516 Assembly • Program Tape Generation 	Processor: Storage: Print: Terminal: Memory: Processing: Other Systems: VAX 11/780 - DECI for interface to Litton LC-4516	<ul style="list-style-type: none"> • Program File Maintenance • Litton LC-4516 Assembly 	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	
	<ul style="list-style-type: none"> • Assembler too slow. To be rehoused on VAX 11/780. 			

*Prime support is provided by VAX 11/780. Support processor can be used as back-up only if it is compatible with VAX 11/780.

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: Assembly	System: EF-111 TJS	Projected Life: Upon replacement of Litton LC-4516 for duration of system life	User/Contact: MURRIC/Hal Maney 4 Nov 80
Description of Function: An assembly capability will be required for the Teledyne processor. (dependent on decision to replace LC-4516.)		Frequency of Function: This ad hoc engineering support for software assembly is used during change processing.	
Current Support		Projected Requirements	
ADPE Resources	Software Functions	ADPE Resources*	Software Functions
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	<ul style="list-style-type: none"> • Program File Maintenance • Litton LC-4516 to Teledyne translation • Teledyne Assembly
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

*Prime support is provided by VAX 11/780. Support processor can be used as back-up only if it is compatible with VAX 11/780.

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function: Edit/Assembly Back-up	System: AN/ALR-62	Projected Life: Life of the system	User/Contact: MERRVB/Ed James	4 Nov 80
Description of Function: A capability is required to provide software edit/assembly facilities in the event of failure of the ALR-62 ISS support processor.		Frequency of Function: This is ad hoc engineering support.		
Current Support		Projected Requirements		
ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions	ADPE Resources Processor: Storage: Print: Terminal: 2 CRT Memory: Processing: Other Systems: Paper Tape Output (NOVA 3D to provide primary E/A support. Support processor as back-up capability only.)	Software Functions • Program file maintenance • CM 456 assembly capability • Update from NOVA 3D for changes	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function: Documentation Support	System: AN/ALR-62	Projected Life: Life of the system	User/Contact: MRRVB/Ed James	4 Nov 80
Description of Function: A capability is required to maintain, edit, format, paginate system documentation.		Frequency of Function: This is an ad hoc function performed whenever a system change necessitates a document change.		
Current Support				
ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions	ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Projected Requirements ADPE Resources	Software Functions • Text Edit • Terminal interface • Document Format
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: V&V Support	System: AN/ALR-62	Projected Life: Life of the system	User/Contact: NERRVB/Ed James 4 Nov 80
Description of Function: A capability is required to track changes for V&V. This capability should document which changes work and which do not. The capability might also be used to track the configuration management process.		Frequency of Function: This is an ad hoc function, performed in conjunction with an emergency or cyclic update.	
Current Support		Projected Requirements	
ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions	ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • Data base structuring • Data base maintenance - add, delete, change • Data inquiry and output formatting
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: Documentation Management	System: AN/ALQ-119	Projected Life: Life of the system	User/Contact: MERRCT/Dean Delaigle 4 Nov 80
Description of Function: The required capability is a comprehensive documentation system including documentation control, maintenance, and production.		Frequency of Function: This is a continuing function. It would be executed on an ad hoc basis for document maintenance and production when changes are made.	
Current Support		Projected Requirements	
ADPE Resources	Software Functions	ADPE Resources	Software Functions
Processor: U1108 Storage: Print: Terminal: Memory: Processing: Other Systems:	• Document Processor for maintenance and production	Processor: Storage: Print: Local print capability Terminal: desired Memory: Processing: Other Systems:	• Document indexing, cataloging, and tracking • Text Editor • Document formatter • Remote print
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations
		• Clerical personnel for document entry and maintenance	

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function:	System:	Projected Life:	User/Contact:
Project Control	AN/ALQ-119	Life of the system	WDRCT/Dean Delaigle
Description of Function: The required capability must provide schedule planning and analysis, monitoring, and highlighting of exception conditions.		Frequency of Function: This would be a periodic function based on a structured planning/reporting cycle.	4 Nov 80
Current Support		Projected Requirements	
ADPE Resources Processor: HP 9845 Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • Schedule Entry • Schedule printing	ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • Schedule entry • Milestone tracking • Slippage reporting and analysis. (Need not be as elaborate as critical path modeling.)
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations
		• Clerical personnel for data entry	

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: Data Reduction/Analysis	System: AN/ALQ-119	Projected Life: Duration of Flight Test Programs	User/Contact: MERRICK/Dean Delaigle 4 Nov 80
Description of Function: The required capability must allow input of data from ISS or flight test and generalized correlation of the data.		Frequency of Function: This is an ad hoc function performed in conjunction with system test.	
Current Support		Projected Requirements	
ADPE Resources	Software Functions	ADPE Resources	Software Functions
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems: Might require external interface with flight test data system (tape)	• ISS interface (tape or direct) • Flight test system interface (tape or direct) • Data base structure • Data base maintenance - entry, deletion, change • Data base extraction and sorting • Generalized statistical functional • Output report formatting
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations
			• Must be capable of varying data analyzed and developing statistics as tests vary.

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: Software Assembly	System: AN/ALQ-119	Projected Life: Life of the system	User/Contact: NEURCT/Dean Delaigle 4 NOV 80
Description of Function: The required capability is a back-up edit/assembly capability to the AN/ALQ-119 ISS.		Frequency of Function: This is a periodic function performed when the ISS is unavailable during a software change.	
Current Support		Projected Requirements	
ADPE Resources	Software Functions	ADPE Resources	Software Functions
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	<ul style="list-style-type: none"> • Program file update from ISS • CX2-475-01 Assembly • Intel 8085 Assembly • Zilog Z80 Assembly
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function:	System:	Projected Life:	User/Contact:	
Threat Data Base Maintenance	EWOLS/BCSAS	Continuous	MURBAA/Harry Jennings	5 Nov 80
Description of Function: The required capability must allow for maintenance of the EWIR data base and extraction and sorting of threat data for EWOLS use.		Frequency of Function: Maintenance is a monthly function. Extraction and sort are ad hoc functions performed when an EWOLS simulation is to be set up.		
Current Support		Projected Requirements		
ADPE Resources Processor: U1108 Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • Data base structuring • Data entry, editing • EWIR data extraction and sorting (This function is an extensive user of U1108.)	ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • Data base structuring • Data entry, addition, deletion, and change • EWIR data extraction and sorting • Output formatting	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: Project Monitoring	System: EWOLS/ECSAS	Projected Life: Continuous	User/Contact: MRDRAA/Harry Jennings 5 Nov 80
Description of Function: The required capability must provide for monitoring of assigned section projects. This includes tracking of milestones and dates, and monitoring of resource assignments. The capability should allow planning and analysis, e.g., PERT or critical path modeling. It should also provide the ability to produce graphic representations of the project schedules.		Frequency of Function: This is a continuous function, performed for each assigned project.	
Current Support		Projected Requirements	
ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions	ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • Data base maintenance - creation and update • Data extraction and sort • Activity network analysis • Plotter support • Exception report generation
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function:	System:	Projected Life:	User/Contact:
Documentation Management	ENOLS/BCSAS	Continuous	HERRAA/Harry Jennings
Description of Function: The required capability is a comprehensive documentation system including cataloging/indexing, document entry, editing and maintenance, and document formatting and production.		Frequency of Function: This is a continuing function, required for all documentation produced by the unit.	
Current Support		Projected Requirements	
ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions <ul style="list-style-type: none"> • Document entry • Editing • Document formatting and printing 	ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions <ul style="list-style-type: none"> • Document cataloging and control • Document entry and editing • Document formatting • Document printing
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function:	System:	Projected Life:	User/Contact:
Automated Mail System	EMOLS/ECSAS	Continuous	WERRAA/Harry Jennings
Description of Function: The required capability should provide a means for rapid distribution of internal mail, assignment and tracking of associated suspenses, audit trail creation, and recipient notification.		Frequency of Function: This is a continuous division support function.	
Current Support		Projected Requirements	
ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions	ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • Mailbox function • Suspense alert • Sign-on identification and recipient alert
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function:	System:	Projected Life:	User/Contact:	
Change Distribution	AN/ALR-46	Duration of system life cycle	MURRYA/Phil Oliver	10 Nov 80
<p>Description of Function:</p> <p>The required capability is to provide an automated medium for distribution of software changes to the field.</p> <p>Frequency of Function:</p> <p>This function is performed whenever a software change is released to the field.</p>				
Current Support		In Process*		
ADPE Resources	Software Functions	ADPE Resources	Software Functions	
<p>Processor: U1108</p> <p>Storage:</p> <p>Print:</p> <p>Terminal:</p> <p>Memory:</p> <p>Processing:</p> <p>Other Systems: Binary tape output device.</p>	<ul style="list-style-type: none"> • AUTODIN tape formatting • Binary tape device driver 	<p>Processor:</p> <p>Storage:</p> <p>Print:</p> <p>Terminal:</p> <p>Memory:</p> <p>Processing:</p> <p>Other Systems: Binary tape output device</p>	<ul style="list-style-type: none"> • AUTODIN tape formatting • Binary tape device driver 	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

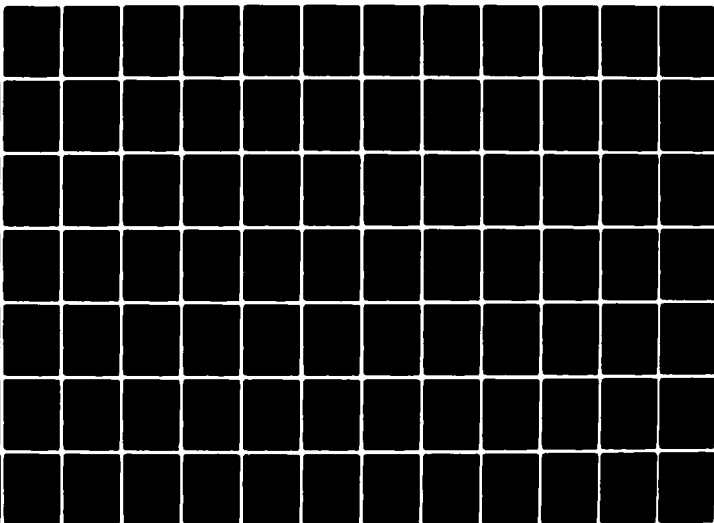
*Binary tape device currently being prototyped.

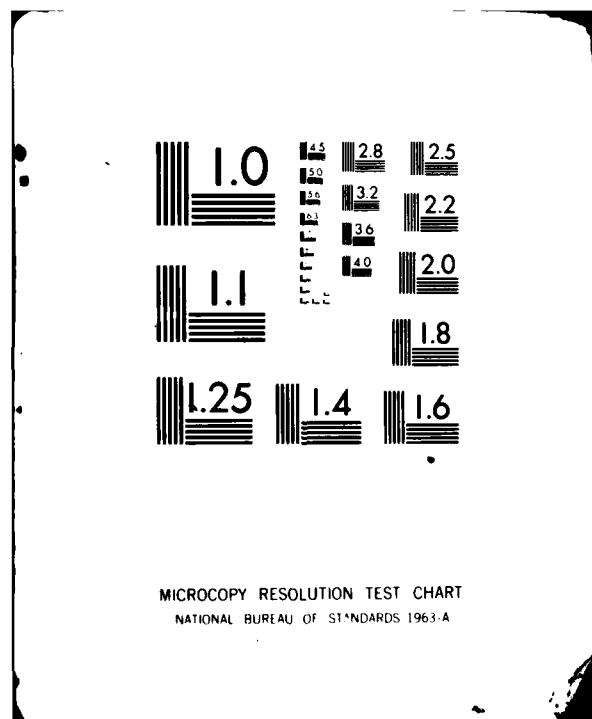
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213
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ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function:	System:	Projected Life:	User/Contact:	
Documentation Management	AN/ALR-46	Life of the system	MRURVA/Phil Oliver	10 Nov 80
Description of Function:		Frequency of Function:		
The required capability must provide for document control (indexing and location), document entry and maintenance, and formatting and production.		This is a continuing function for control of documents and an ad hoc function for document maintenance, performed when software changes are made.		
Current Support		Projected Requirements		
ADPE Resources	Software Functions	ADPE Resources	Software Functions	
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	<ul style="list-style-type: none"> • Document Cataloging • Document Processing 	Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	<ul style="list-style-type: none"> • Document indexing/cataloging • Document entry and edit • Document formatting and production 	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function: Data Reduction	System: AN/ALR-46	Projected Life: During flight test program	User/Contact: MURRAY/Phil Oliver	10 Nov 80
Description of Function: The required capability must provide for acceptance of pod-recorded flight data, and reduction and correlation of that data with ground-generated data.		Frequency of Function: This is an ad hoc function performed to derive performance verification data not available from the ISS.		
Current Support		Projected Requirements		
ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions	ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • Input program for flight test data (pod and ground station) • Data base structuring • Data base maintenance - entry, edit • Data base extraction and sort • Correlation program • Report formatter	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function: Project Control	System: AN/ALR-46	Projected Life: Continuous	User/Contact: HNSRVA/Phil Oliver	10 Nov 80
Description of Function: The required capability must provide for schedule and manpower planning and feasibility analysis, progress tracking against milestones, and exception reporting of slippages or delays.		Frequency of Function: This function would be periodic for each project tracked.		
Current Support		Projected Requirements		
ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • Milestone Tracking	ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • Schedule entry • Manpower and resources allocation • Progress reporting and updating • Slippage identification, reporting, and analysis • Schedule feasibility analysis	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: Assembly/Edit	System: AN/ALR-69 Update	Projected Life: Life of the system	User/Contact: MRRVA/Ed Hillhouse 20 Nov 80
Description of Function: The required capability must provide a back-up edit and assembly facility for the ALR-69 update processor software.		Frequency of Function: This is an ad hoc function performed when the ISS processor is unavailable during a software change.	
Current Support		Projected Requirements	
ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions	ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • Program file maintenance • Text edit • ATAC 16M assembly
Personnel Resources	Constraints or Limitations	Personnel Resources • Engineers as required for software change	Constraints or Limitations

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function: System Reprogramming	System: AM/ALR-69 Update	Projected Life: Life of the system	User/Contact: MERRVA/Ed Hillhouse	20 Nov 80
Description of Function: This capability must provide for creation and distribution of tapes for software reprogramming in the field.		Frequency of Function: This is an ad hoc function required at the completion of a software change.		
Current Support*		Projected Requirements		
ADPE Resources	Software Functions	ADPE Resources	Software Functions	
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	• Tape data formatting • Output driver for tape device	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

*A capability to produce distribution tapes on the U1108 is being prototyped.

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: Project Control	System: AN/ALR-69 (update)	Projected Life: Continuous	User/Contact: WBRVA/Ed Hillhouse 20 Nov 80
Description of Function: The required capability would provide scheduled planning, progress reporting, and report preparation for assigned projects.		Frequency of Function: This is a periodic function when applied to the assigned projects, which occur on an ad hoc basis.	
Current Support*			
ADPE Resources	Software Functions	ADPE Resources	Software Functions
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	<ul style="list-style-type: none"> • Schedule entry • Milestone tracking • Report preparation
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

*limited milestone capability available on U1108.

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: System Modeling	System: AM/ALR-69 (Update)	Projected Life: Life of the system	User/Contact: HARRVA/BA Hillhouse 20 Nov 80
Description of Function: The required capability would allow off-line simulation of system design and functions for the purpose of evaluating design and software implementations.		Frequency of Function: This is an ad hoc function.	
Current Support*		Projected Requirements	
ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions	ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • System model (level undetermined) • Software model
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

*Seen to be a requirement in the near time frame, i.e., by 1982.

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: Edit/Assembly	System: AN/ALR-69	Projected Life: Life of the system	User/Contact: HARRVC/John Louth 20 Nov 80
Description of Function: The required capability must provide ability to modify and assemble AN/ALR-69 software.		Frequency of Function: This is an ad hoc function performed when ISS processor is unavailable during a software change.	
Current Support		Projected Requirements	
ADPE Resources	Software Functions	ADPE Resources	Software Functions
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	• CH-474 Assembly	Processor: Mass data storage entry - Storage: ISS compatible Print: Local to ISS Terminal: Memory: Processing: Other Systems:	• Program file maintenance • Text edit • CH-479 Assembly • ATC-8 Assembly
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: Documentation Management	System: AM/ALR-69	Projected Life: Life of the system	User/Contact: HARRVC/John Louth 20 Nov 80
Description of Function: The required capability should provide for identifying, tracking, and maintaining system documentation.		Frequency of Function: This is an ad hoc function performed when status or content of documents changes.	
Current Support		Projected Requirements	
ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • Document Processor • Flowcharter	ADPE Resources Processor: Storage: Print: Local Printers in ISS Terminal: Memory: Processing: Other Systems: Plotter Graphics	Software Functions • Document catalog/index • Document entry • Text editor • Document formatter • Document production • Flowchart preparation
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: Software Change Distribution	System: AN/ALR-69	Projected Life: Life of the system	User/Contact: MERRVC/John Louth 20 Nov 80
Description of Function: The required capability should provide for distribution of software changes to the field via AUTODIN.		Frequency of Function: This is an ad hoc function performed at the completion of a software change.	
Current Support *		Projected Requirements	
ADPE Resources	Software Functions	ADPE Resources	Software Functions
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	<ul style="list-style-type: none"> AUTODIN tape data formatter Binary tape output device driver
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations
			<ul style="list-style-type: none"> Transfer media subject to change at field level.

*A binary tape output device for AUTODIN tapes is currently being prototyped.

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function: Suspense Tracking	System: AN/ALR-69	Projected Life: Continuous	User/Contact: NERRVC/John Louth	25 Nov 80
Description of Function: The required capability should provide for establishment and notification of suspense items, and threshold and exception conditions of suspense items.		Frequency of Function: This function is initiated by ad hoc entry of a suspense item and date. Subsequent monitoring is periodic.		
Current Support		Projected Requirements		
ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions	ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems: *If CRT notification is used, extensive terminal facilities are required.	Software Functions • Suspense item entry • Status modification • Date comparison and threshold/exception reporting	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function:	System:	Projected Life:	User/Contact:
Document Control	AN/ALQ-131	Life of the system	MWRCC/Bobby McDonald 25 Nov 80
Description of Function:		Frequency of Function:	
This required capability would allow cataloging and locating system documentation.		This is an ad hoc function performed when documentation content or status changes.	
Current Support		Projected Requirements	
ADPE Resources	Software Functions	ADPE Resources	Software Functions
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	• Documentation maintenance • Document status report generation
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function:	System:	Projected Life:	User/Contact:
Project Control System	AN/ALQ-131	Continuous	HNRCC/Bobby McDonald
Description of Function: The required capability must provide schedule planning and analysis, monitoring, and highlighting of exception conditions.		Frequency of Function: This is a continuing function. It would be executed on an ad hoc basis for projects when originated and on a periodic basis to project completion.	
Current Support		Projected Requirements	
ADPE Resources	Software Functions	ADPE Resources	Software Functions
Processor: U1108 Storage: Print: Terminal: Memory: Processing: Other Systems:	<ul style="list-style-type: none"> Milestone tracking 	Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	<ul style="list-style-type: none"> Schedule entry Progress reporting and status update Slippage identification and reporting Schedule slippage analysis
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function: Edit/assembly	System: AN/ALQ-131	Projected Life: Life of the system	User/Contact: MEMRCC/Bobby McDonald	25 Nov 80
Description of Function: The required capability should provide a back-up edit and assembly capability.		Frequency of Function: This is an ad hoc function, performed when the ISS processor is unavailable during a software change.		
Current Support		Projected Requirements		
ADPE Resources	Software Functions	ADPE Resources	Software Functions	
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	<ul style="list-style-type: none"> • Program file maintenance • Millicomputer assembly 	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function:	System:	Projected Life:	User/Contact:	
Documentation Support	AM/ALQ-131	Life of the system	MEMROC/Bobby McDonald	25 Nov 80
Description of Function:		Frequency of Function:		
The required capability should provide automatically generated software documentation during the assembly/binding processes.		This function is performed when software is released.		
Current Support				
ADPE Resources	Software Functions	ADPE Resources	Software Functions	
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	• Document Processor	Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	• Memory map • Load map • Subroutine interface listing • Software flow chart • Document processor	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: Suspense Tracking	System: AN/ALQ-131	Projected Life: Continuous	User/Contact: HERRICK/Bobby McDonald 25 Nov 80
Description of Function: The required capability should provide for establishment and notification of suspense items, and threshold and exception reporting of suspense items.		Frequency of Function: This function is initiated by ad hoc entry of a suspense item and date. Subsequent monitoring is periodic.	
Current Support		Projected Requirements	
ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions	ADPE Resources Processor: Storage: Print: Terminal: * Memory: Processing: Other Systems: *If CRT notification is used, extensive terminal facilities will be required.	Software Functions * Suspense item entry * Status modification * Date comparison and threshold/exception reporting
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function:	System:	Projected Life:	User/Contact:	
Software Archive	P-15 TMS	Life of the system	NEEDIT/Steve Strawn	25 Nov 80
Description of Function:		Frequency of Function:		
The required capability is to provide a back-up software archive facility.		This would be a periodic function; periodicity is to be determined.		
Current Support		Projected Requirements		
ADPE Resources	Software Functions	ADPE Resources	Software Functions	
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	<ul style="list-style-type: none"> • Transfer and store software from Harris computer to support processor • Retrieve and restore software as required 	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	
			<ul style="list-style-type: none"> • Archive should provide separate facility for storage to avoid catastrophic loss. 	

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function: AM/ALR-56 and AM/ALQ-135 Software Generation Support	System: F-15 TENS	Projected Life: Life of the system	User/Contact: HARRIT/Steve Strawn	25 Nov 80
Description of Function: The requirement is to provide a back-up software generation and test capability.		Frequency of Function: This would be an ad hoc function, performed during a software update when the ISS is unavailable.		
Current Support		In process*		
ADPE Resources Processor: U1108 Storage: Print: Terminal: Memory: Processing: Other Systems:		Software Functions	ADPE Resources	Software Functions • TI 2520-2 cross assembler • TI 2520-2 relocatable library • TI 2520-2 off-line simulator • PROM program generator • Program file maintenance • Text edit
Personnel Resources		Constraints or Limitations	Personnel Resources	Constraints or Limitations

*Currently being hosted on U1108.

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: Flight Test Analysis	System: F-15 TENS	Projected Life: Life of the system	User/Contact: MURRIT/Steve Strawn 25 Nov 80
Description of Function: The requirement is to collect, sort, and analyze flight range data, as currently supported.		Frequency of Function: This is an ad hoc function.	
Current Support			
ADPE Resources Processor: U1108 & Harris Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • Flight test data input • Flight test data reduction • Flight track error plotting	ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems: plotter graphics	Software Functions • Flight test data input • Flight test data reduction/correlation • Flight track error plotting
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: ALE-45 Software Generation	System: F-15 TEMS	Projected Life: Life of the system	User/Contact: MMRRIT/Steve Strawn 25 Nov 80
Description of Function: The requirement is to provide a back-up software generation and test capability for the ALE-45.		Frequency of Function: This is an ad hoc function, performed during a software update when the ISS is unavailable.	
Current Support In process		Projected Requirements	
ADPE Resources Processor: U1108 Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • Motorola 6800 cross assembler • Motorola 6800 simulator	ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • Program file maintenance • Text edit • Motorola 6800 cross assembler • Motorola 6800 simulator
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

ADP REQUIREMENT 1: SPECIFICATIONS				
Required ADP Function: Mission Support	System: F-15 TAMS	Projected Life: Life of the system	User/Contact: NABIR/Steve Strawn	25 Nov 80
Description of Function: The requirement is to provide the capability to output preflight messages (PFM) for field updates to EIDs.		Frequency of Function: This is an ad hoc function, as required by threat changes.		
Current Support				
ADPE Resources	Software Functions	ADPE Resources	Software Functions	
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems: Binary tape output device	• EID extraction and data formatting • PFM generation/formatting • Binary tape device driver	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function: ISS Configuration Management	System: F-15 TEMS	Projected Life: Life of ISS	User/Contact: MMRRIT/Steve Strawn	25 Nov 80
Description of Function: The requirement is to maintain and print the F-15 TEMS ISS wirelist (pin connections).		Frequency of Function: This is an ad hoc function performed when the ISS configuration changes.		
Current Support		Projected Requirements		
ADPE Resources	Software Functions	ADPE Resources	Software Functions	
Processor: U1108 Storage: Print: Terminal: Memory: Processing: Other Systems:	<ul style="list-style-type: none"> • Data file structuring • Wirelist entry • Data updating -- add, delete, modify • Wirelist printing 	Processor: Support Processor Storage: Print: Terminal: Memory: Processing: Other Systems: Potential use of plotter graphics	<ul style="list-style-type: none"> • Data base structuring • Data base conversion • Wirelist updating • Wirelist printing 	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function:	System:	Projected Life:	User/Contact:	
Data Management	F-15 TENS	Life of the system	HERRIT/Steve Strawn	25 Nov 80
Description of Function:		Frequency of Function:		
The desired capability is to provide a means for maintaining software documentation automatically.		This is an ad hoc function, performed when a software change is made.		
Current Support		Projected Requirements		
ADPE Resources	Software Functions	ADPE Resources	Software Functions	
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	• Memory map • Load map • Subroutine interface listing • Software flow charting • Document processor	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function:	System:	Projected Life:	User/Contact:
Data Management		Continuous	MMEC/Henry McGirt 2 Dec 80
Description of Function: The requirement is for a document control system.		Frequency of Function: This is an ad hoc function, used to log and track documents as received.	
Current Support		Projected Requirements	
ADPE Resources	Software Functions	ADPE Resources	Software Functions
Processor: INTERDATA 32 Storage: Print: Terminal: Memory: Processing: Other Systems:	• Data management system	Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	• Data management system
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function:	System:	Projected Life:	User/Contact:
Data Management	AN/ALQ-155	Life of the system	HEBRCS/Dennis Thomas
Description of Function: The required capability is to identify, locate, and maintain system documentation.		Frequency of Function: This is an ad hoc function.	
Current Support			
ADPE Resources	Software Functions	ADPE Resources	Software Functions *
Processor: U1108 Storage: Print: Terminal: Memory: Processing: Other Systems:	• Document entry • Document updating/editing • Document printing • Document cataloging	Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	• Document cataloging
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

*Document storage, maintenance, and production being placed on word processor.

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function:	System:	Projected Life:	User/Contact:
Project Control	AN/ALQ-155	Continuous	MMRCS/Dennis Thomas
Description of Function: The requirement is to provide a project planning, status tracking, resource tracking, and reporting capability.		Frequency of Function: This would be an ad hoc function at project initiation. Status reporting would be periodic.	
Current Support		Projected Requirements	
ADPE Resources	Software Functions	ADPE Resources	Software Functions
Processor: U1108 Storage: Print: Terminal: Memory: Processing: Other Systems:	<ul style="list-style-type: none"> • Schedule entry • Schedule status reporting 	Processor: Storage: Print: Local print capability Terminal: desired Memory: Processing: Other Systems: Plotter graphics	<ul style="list-style-type: none"> • Schedule entry • Manpower/resource allocation • Progress reporting and updating • Slippage identification and analysis (Need not be as elaborate as PERT or critical-path modeling.) • Manpower/resource tracking
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function:	System:	Projected Life:	User/Contact:
Software Analysis	AW/ALQ-155	Life of the system	WBRCS/Dennis Thomas 3 Dec 80
Description of Function: The requirement is to provide a capability to analyze software implementations to determine choke points, frequency of code execution, instruction timings, and other performance parameters in order to fine tune the software in response to changing requirements.		Frequency of Function: This is an ad hoc function.	
Current Support		Projected Requirements	
ADPE Resources	Software Functions	ADPE Resources	Software Functions
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems: May involve ISS software for data collection	• Software execution data collection • Software data correlation • Statistics report generation
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function: Project Control	System: AN/APR-38, AN/APR-125	Projected Life: Life of the system	User/Contact: HARRIA/John Lavecchia	4 Dec 80
Description of Function: The required capability must provide schedule planning and analysis, monitoring, and highlighting of exception conditions.		Frequency of Function: This function would be periodic, based on a structured planning/reporting cycle.		
Current Support		Projected Requirements		
ADPE Resources Processor: HP 9845 Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • Schedule entry • Schedule printing	ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems: Plotter graphics	Software Functions • Schedule entry • Milestone tracking • Slippage reporting and analysis (Need not be as elaborate as critical path modeling.) • Milestone chart development	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: Data Reduction/Analysis	System: AN/APR-38	Projected Life: Duration of flight test programs	User/Contact: MERRIA/John Lavecchia 4 Dec 80
Description of Function: The required capability must allow input of data from ISS or flight test and generalized correlation of the data.		Frequency of Function: This is an ad hoc function performed in conjunction with system test.	
Current Support			
ADPE Resources	Software Functions	ADPE Resources	Software Functions
Processor: PDP-11/34 Storage: Print: Terminal: Memory: Processing: Other Systems:	<ul style="list-style-type: none"> • Flight data input • Flight data correlation • Report generation 	Processor: Storage: Print: Terminal: Memory: Processing: Other Systems: Might require external interface with flight test data system (data link desired)	<ul style="list-style-type: none"> • Flight test system interface (direct preferred) • Data base structure/data entry • Data base extraction, sorting, and correlation • Generalized statistical calculation • Output report formatting
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function: Documentation Management	System: AN/APR-38, AN/APR-125	Projected Life: Life of the system	User/Contact: MIRRIA/John Lavecchia	4 Dec 80
Description of Function: The required capability is a comprehensive documentation system including documentation control, maintenance, and production.		Frequency of Function: This is a continuing function. It would be executed on an ad hoc basis for document maintenance and production when changes are made.		
Current Support		Projected Requirements		
ADPE Resources Processor: U1108 Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • Document processor for maintenance and production	ADPE Resources Processor: Storage: Print: Local print capability desired Terminal: Memory: Processing: Other Systems:	Software Functions • Document indexing, cataloging, and tracking • Text edit • Document format • Remote printing	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: PRE-PHRT Validation and Verification	System: QM-1	Projected Life: To 1986 - Projected to be supported by HEC there-after*	User/Contact: HECDA/Vic Vajo
Description of Function: The requirement is to support software vsv prior to development of AISP by providing processor emulation and environmental simulation capabilities.		Frequency of Function: These are ad hoc functions.	
Current Support		Projected Requirements	
ADPE Resources Processor: U1108 Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • SMITE emulation compiler (requires PL/1 level 9 compiler) • HEC meta assembler	ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems: Data link to QM-1 to provide environmental simulation	Software Functions • Emulation compiler (SMITE) • Generalized cross assembler (HDCAC)
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

*Workload projected to increase beyond shared support processor capability.

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function:	System:	Projected Life:	User/Contact:
Validation and Verification (V&V)		To 1986 - Projected to be supported by MMEC thereafter.	MMECDA/Vic Vajo
Description of Function: The requirement is to provide software test tools to support software V&V. These may be generalized or target processor specific.		Frequency of Function: These would be ad hoc functions.	
Current Support		Projected Requirements	
ADPE Resources	Software Functions	ADPE Resources	Software Functions
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	• Syntax analysis - corrections • Semantic analysis - code optimization • Test Data Generators • General Purpose Translators • Smart Editors
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations
			• Definition of these test tools is currently under way. Details may depend on schedules of transitioning software.

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function:	System:	Projected Life:	User/Contact:	
Management Information		Continuous	MMBC/John Echols	9 Dec 80
Description of Function:		Frequency of Function:		
MMBC supports its engineering management information requirements using the Engineering Data Management System (EDMS). EDMS provides project schedule and manpower planning and control, configuration status accounting, and change process management capabilities.		This is a continuous function.		
Current Support		Projected Requirements		
ADPE Resources	Software Functions	ADPE Resources	Software Functions	
Processor: INTERDATA 8/32 Storage: (Rehosting on U1108) Print: Terminal: Memory: Processing: Other Systems:	EDMS (as above) • Interactive data entry and maintenance • Periodic report generation • Status monitoring • Manpower tracking	Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	EDMS (as above) • Interactive data entry and maintenance • Periodic report generation • Status monitoring • Manpower tracking	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function:	System:	Projected Life:	User/Contact:	
Edit/Assembly		Continuous	WMEC/R. Coker	10 Dec 80
Description of Function: The requirement is to provide a back-up general purpose, i.e., machine independent edit/assembly capability.				
Frequency of Function: This is an ad hoc function.				
Current Support		Projected Requirements		
ADPE Resources	Software Functions	ADPE Resources	Software Functions	
Processor: INTERDATA 32, Harris* Storage: Print: Terminal: Memory: Processing: Other Systems:	• Interactive program file maintenance • DUAL cross assembler	Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	• Program file maintenance or transfer • Text editor • Assembly of code for a variety of processors	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

*Reliability and multiuser limitations

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: Failure Data Analysis	System: ATE	Projected Life: Continuous	User/Contact: HMEC/Don Purvis 10 Dec 80
Description of Function: This requirement should provide trend analysis of failure data.		Frequency of Function: This is a periodic function.	
Current Support			
ADPE Resources	Software Functions	ADPE Resources	Software Functions
Processor: Harris* Storage: Print: Terminal: Memory: Processing: Other Systems: RJET (SEL/32)	<ul style="list-style-type: none"> Data base update Failure data analysis Report generation 	Processor: Storage: Print: Terminal: Memory: Processing: Other Systems: Link to Hill AFB computer for data (RJET)	<ul style="list-style-type: none"> Data base conversion Data base update Failure data analysis Report generation
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

*Experiencing access and reliability problems. Need near-term support.

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function: Data Management	System: JTIDS	Projected Life: Life of the system - 1984+	User/Contact: MDEC/Jim McKeen	11 Dec 80
Description of Function: Desire a centralized capability to maintain system documentation.		Frequency of Function: This is an ad hoc function.		
Current Support (Not yet required)				
ADPE Resources	Software Functions	ADPE Resources	Software Functions	
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	<ul style="list-style-type: none"> • Interactive document entry • Document and page formatting • Text editing • Output printing 	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function: Software Generation	System: GPS	Projected Life: Life of the system	User/Contact: MUSC/Jim Miller	16 Dec 80
Description of Function: The requirement is to provide software compilation and assembly for GPS processor.		Frequency of Function: This is an ad hoc function.		
Current Support (Not yet required)		Projected Requirements		
ADPE Resources	Software Functions	ADPE Resources	Software Functions	
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	• Text editing • Journal J73 compiler • ADA compiler • Cross assembly for user segment processor	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function: Engineering Management	System: GPS	Projected Life: Continuous	User/Contact: NEBC/Jim Miller	16 Dec 80
Description of Function: The requirement is to provide project schedule and manpower planning and control, configuration status accounting, and change process management capabilities.		Frequency of Function: This is a continuing function.		
Projected Requirements				
Current Support		ADPE Resources	Software Functions	
Processor: INTERDATA 8/32 Storage: (Rehosting on U1108) Print: Terminal: Memory: Processing: Other Systems:	EDMS • Interactive data entry and maintenance • Periodic report generation • Status monitoring • Manpower tracking	Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	EDMS • Interactive data entry and maintenance • Periodic report generation • Status monitoring • Manpower tracking	
Personnel Resources		Constraints or Limitations		

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function:	System:	Projected Life:	User/Contact:	
Document Control	GPS	Life of the system	WBC/Jim Miller	16 Dec 80
Description of Function: This required capability would allow cataloging and locating system documentation.		Frequency of Function: This is an ad hoc function performed when documentation content or status changes.		
Current Support (Not yet required)		Projected Requirements		
ADPE Resources	Software Functions	ADPE Resources	Software Functions	
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	• Documentation maintenance • Document status report generation	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function:	System:	Projected Life:	User/Contact:	
Software Documentation	GPS	Life of the system	NMEC/Jim Miller	16 Dec 80
Description of Function: The desired capability is to produce flow charts from structure design language or code.		Frequency of Function: This is an ad hoc function, performed when software flow changes.		
Current Support		Projected Requirements		
ADPE Resources	Software Functions	ADPE Resources	Software Functions	
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	• Structured code processor • Flow chart program for structured code	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function: Validation and Verification	System: ANRAAH	Projected Life: 1985-1986	User/Contact: HDEC/Don Parrish	16 Dec 80
Description of Function: The requirement is to support software V&V prior to development of ISS by providing processor emulation and environmental simulation capability of guided test vehicle programs.		Frequency of Function: These are ad hoc functions.		
Current Support In process		Projected Requirements		
ADPE Resources Processor: U1108 Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • SMITE emulation compiler • HDEC meta assembler	ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems: Data link to QM-1 to provide environmental simulation	Software Functions • Emulation compiler (SMITE) • Generalized cross assembler (HDEC)	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: Repository	System: Software Tools Group	Projected Life: Continuous	User/Contact: MMRRAA/Harold Kimball 16 Dec 80
Description of Function: The capability would provide a central archive and library for current software, test data and scenarios, and documentation.		Frequency of Function: This would be a continuing function.	
Current Support		Projected Requirements	
ADPE Resources	Software Functions	ADPE Resources	Software Functions
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	• System cataloging • File editing, archiving, and identification • Data access - text - code - data • File transfer
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: Software Analysis	System: Software Tools Group	Projected Life: Continuous	User/Contact: MMRRAA/Harold Kimball, Marv Harbert 16 Dec 80
Description of Function: This function should provide the capability of syntactic, semantic analysis and optimization of software generated in MMRR.		Frequency of Function: This would be an ad hoc function.	
Current Support Partially		Projected Requirements	
ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • Semantic analyzer for assembly language	ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • Language translators (required to develop meta language if general-purpose analyzers are used) • Syntactic Analyzer • Semantic Analyzer • Languages Include: Pascal Ada JOVIAL J73 Fortran IV COBOL APL FORTH
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function:	System:	Projected Life:	User/Contact:
Configuration Management	Software Tools Group	Continuous	WARRA/Spurgeon Robinette
Description of Function: This requirement should provide for automated support of the configuration management process, including: <ul style="list-style-type: none"> • ECP initiation and tracking • Suspense management • CPCSB agenda development • Block-cycle reporting 		Frequency of Function: This is a continuing function.	
Current Support		Projected Requirements	
ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions	ADPE Resources Processor: Storage: Print: Terminal: Terminal capability for all SP and CPCSB members.* Memory: Processing: Other Systems:	Software Functions • ECP identification and distribution • Suspense establishment • Suspense threshold reporting • ECP status reporting • ECP status update and approval monitoring • Configuration/effectivity analysis • Configuration status accounting • CPCSB agenda development • Block-cycle tracking
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

*SP - Screening panel; CPCSB - computer program configuration subboard.

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: Program History	System: AN/ALR-69 (Update)	Projected Life: Continuous	User/Contact: MURPHY/Jim Huffman, Denny Mullens
Description of Function: This requirement is to create an automated audit trail of program budget, logistics, and technical actions. The function would allow continuity of program processes even though personnel might shift.		Frequency of Function: This would be a continuing function.	
Current Support			
ADPE Resources	Software Functions	ADPE Resources	Software Functions
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	<ul style="list-style-type: none"> • Text item entry • Context search recall • Chronological recall
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function: Archive	System: AN/ALR-69 (Update)	Projected Life: Life of the system	User/Contact: HARRT/Jim Huffman, Denny Mullens	17 Dec 80
Description of Function: This requirement should allow on-line storage and recall of program documents.		Frequency of Function: This is an ad hoc function.		
Current Support Partially		Projected Requirements		
ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • Document processor	ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems: OCR input capability for existing documentation.	Software Functions • Document identification • Document entry • Document recall and search • Document printing	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: Project Planning	System: AN/ALR-69 (Update)	Projected Life: Life of the system	User/Contact: HERBERT/Jim Huffman, Denny Mullens 17 Dec 80
Description of Function: This requirement should provide for project schedule planning, including development and recall of standard activity networks, feasibility analysis of schedules, milestone or activity chart production, and reference data for program planning, e.g., initiation and contract lead times.		Frequency of Function: This would be an ad hoc function, performed at program initiation and at other times when program schedules might change.	
Current Support		Projected Requirements	
ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • Milestone schedule entry and monitoring	ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems: Plotter graphics	Software Functions • Schedule development • Standard activity maintenance • Schedule feasibility analysis • Milestone/activity chart production
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function:	System:	Projected Life:	User/Contact:	
Procurement Preparation	AN/ALR-69 (Update)	Life of the system	HERBERT/Jim Huffman, Denny Mullens	17 Dec 80
<p>Description of Function:</p> <p>This requirement would provide for automated support to Contract Data Requirements List (CDRL) development. Standard packages of data item descriptions would be developed and maintained for selection, modification, or inclusion in the procurement package.</p> <p>Frequency of Function:</p> <p>This would be an ad hoc function.</p>				
Current Support		Projected Requirements		
<p>ADPE Resources</p> <p>Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:</p>	<p>Software Functions</p>	<p>ADPE Resources</p> <p>Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:</p>	<p>Software Functions</p> <ul style="list-style-type: none"> • Development of CDRL data base • Update of CDRL data base • Retrieval and printing of CDRL packages 	
<p>Personnel Resources</p>	<p>Constraints or Limitations</p>	<p>Personnel Resources</p>	<p>Constraints or Limitations</p>	

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function:	System:	Projected Life:	User/Contact:
Logistics Support	AN/ALR-69 (Update)	Life of the system	HEPBT/Jim Huffman, Denny Mullens
Description of Function: This requirement would provide for an automated parts reference data base to include: <ul style="list-style-type: none"> • Parts numbers • Descriptive data • Maintenance/repair codes • Requirements factors • Interchangeability • Special tools The requirement would also provide Logistics Support Analysis (LSA) and level-of-repair (LOR) analysis.		Frequency of Function: This is an ad hoc function.	
Current Support		Projected Requirements	
ADPE Resources	Software Functions	ADPE Resources	Software Functions
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	<ul style="list-style-type: none"> • Data base structuring • Data bulk loading • Data maintenance - add, delete, modify • Interactive inquiry • List generation • LOR Model
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function:	System:	Projected Life:	User/Contact:
GFE Accountability	AN/ALR-69 (Update)	Life of the system	MMRT/Jim Huffman, Denny Mullens
Description of Function: This requirement would provide for identification and scheduling of GFE requirements and monitoring status and accountability and disposition of GFE items.		Frequency of Function: This function would be initiated at the entry of GFE requirements, and be triggered by GFE dates thereafter.	
Current Support		Projected Requirements	
ADPE Resources	Software Functions	ADPE Resources	Software Functions
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	• Data base structure • GFE data entry • GFE data update • Status report generation
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: Life-Cycle-Cost Analysis	System: AN/ALR-69 (Update)	Projected Life: Life of the system	User/Contact: MURPHY/Jim Huffman, Denny Mullens 17 Dec 80
Description of Function: This requirement would provide a model for projection of system life-cycle costs based on varying support concepts, program and equipment changes, and changes in requirements parameters.		Frequency of Function: This would be an ad hoc function.	
Current Support		Projected Requirements	
ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions	ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • Cost factors data base creation • Cost factors data base maintenance • Life-cycle-cost modeling • NRE-to-date reporting • Investment cost-to-date reporting • O&S cost-to-date reporting
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function:	System:	Projected Life:	User/Contact:	
Budget Preparation	AN/ALR-69 (Update)	Life of the system	MMBMT/Jim Huffman, Denny Mullens	17 Dec 80
Description of Function:		Frequency of Function:		
This function would provide automated maintenance of the program budget data base and creation of budgetary submissions and would consolidate data for all budget sources.		This would be a periodic function, aligned with the annual budget cycle.		
Current Support		Projected Requirements		
ADPE Resources	Software Functions	ADPE Resources	Software Functions	
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	• Budget data base creation • Budget data base maintenance • Budget submission report generator	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function:	System:	Projected Life:	User/Contact:
FMS Accounting		Continuous	MMRR/ Bill Peters
Description of Function:		Frequency of Function:	
<p>FMS Security Assisted Software Support (SASS) will function as ISSs for each FMS case and will likely require the same central support as the USAF system. Due to the cost accounting requirements of FMS, a support processor cost accrual system is required to determine reimbursement for usage.</p>		<p>This will be a continuous function.</p>	
Current Support Partially		Projected Requirements	
ADPE Resources	Software Functions	ADPE Resources	Software Functions*
<p>Processor: U1108</p> <p>Storage:</p> <p>Print:</p> <p>Terminal:</p> <p>Memory:</p> <p>Processing:</p> <p>Other Systems:</p>	<p>U1108 operating system accounting package (Billing algorithm to be established.)</p>	<p>Processor:</p> <p>Storage:</p> <p>Print:</p> <p>Terminal:</p> <p>Memory:</p> <p>Processing:</p> <p>Other Systems:</p>	<p>• System accounting package</p> <p>• Billing algorithm</p> <p>• Manpower cost accrual system</p> <p>• Consumables accounting</p>
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

*Cost accrual systems could be included in an algorithm based on usage data from system accounting package. Security is critical.

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function: User Cost Accounting		System:	Projected Life: Continuous	User/Contact: MNRW/Roger Boan 18 Dec 80
Description of Function: There is a requirement for internal planning purposes to establish a cost accrual and estimation system. It will be mandatory to support FMS cases. Costs must be accrued by project, individual, system, and budgetary source.		Frequency of Function: This is a periodic function, period to be determined.		
Current Support		Projected Requirements		
ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions	ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • Data base creation • Manpower reporting • Consumables cost reporting • Equipment usage reporting • Capital acquisition reporting	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: Checkbook	System:	Projected Life: Continuous	User/Contact: MURRW/Roger Boan 18 Dec 80
Description of Function: The requirement is to provide MWR personnel with budgetary "checkbooks" to account for funds status by source, type, recipient, and purpose, and to provide an audit trail of budgetary actions.		Frequency of Function: This is a periodic function, period to be determined.	
Current Support Partially		Projected Requirements	
ADPE Resources	Software Functions	ADPE Resources	Software Functions
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	<ul style="list-style-type: none"> • Periodic reporting from comptroller's office 	Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	<ul style="list-style-type: none"> • Budget establishment • Budget maintenance • Funding action entry • Checkbook resolution • Funding status report generation • Historical data collection
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function: Project Control	System:	Projected Life: Continuous	User/Contact: MRRW/Roger Boan	18 Dec 80
Description of Function: The required capability must provide for schedule and manpower planning and feasibility analysis, progress tracking against milestones, and exception reporting of slippages or delays.		Frequency of Function: This function would be periodic for each project tracked.		
Current Support		Projected Requirements		
ADPE Resources	Software Functions	ADPE Resources	Software Functions	
Processor: U1108 Storage: Print: Terminal: Memory: Processing: Other Systems:	<ul style="list-style-type: none"> Milestone tracking 	Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	<ul style="list-style-type: none"> Schedule entry Manpower/resource allocation Progress reporting and updating Slippage identification, reporting, and analysis Schedule feasibility analysis Conflict identification 	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: Automated Calendar	System:	Projected Life: Continuous	User/Contact: MERRIN/Roger Boan 18 Dec 80
Description of Function: The required capability should provide for establishment and notification of milestone dates and suspense items and threshold and exception conditions. It should provide automated notification by individual of impending milestones or suspense items.		Frequency of Function: This function is initiated by ad hoc entry of a milestone/suspense item and date. Subsequent monitoring is periodic.	
Current Support		Projected Requirements	
ADPE Resources	Software Functions	ADPE Resources	Software Functions
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	• Milestone/suspense item entry • Status modification • Date comparison and threshold/exception reporting
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

*If CRT notification is used, extensive terminal facilities will be required.

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function:	System:	Projected Life:	User/Contact:	
Project Control	U1108	Continuous	MURRAY/BOB Wade	18 Dec 80
Description of Function:		Frequency of Function:		
The required capability must provide for schedule and manpower planning and feasibility analysis, progress tracking against milestones, and exception reporting of slippages or delays.		This function would be periodic for each project tracked.		
Current Support		Projected Requirements		
Partially				
ADPE Resources	Software Functions	ADPE Resources	Software Functions	
Processor: U1108 Storage: Print: Terminal: Memory: Processing: Other Systems:	<ul style="list-style-type: none"> Milestone tracking 	Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	<ul style="list-style-type: none"> Schedule entry Manpower/resource allocation Progress reporting and updating Slippage identification, reporting, and analysis Schedule feasibility analysis 	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function:	System:	Projected Life:	User/Contact:	
Performance Measurement	U1108	Life of Support Processor	MERRAR/Bob Wade	18 Dec 80
<p>Description of Function:</p> <p>The requirement exists to determine system usage by EM system, user and individual, and to monitor system performance, e.g., I/O wait times, memory allocations, throughput.</p> <p>Frequency of Function:</p> <p>This is a continuing function.</p>				
<p>Current Support Partially</p>				
<p>ADPE Resources</p> <p>Processor: U1108</p> <p>Storage:</p> <p>Print:</p> <p>Terminal:</p> <p>Memory:</p> <p>Processing:</p> <p>Other Systems:</p>		<p>Software Functions</p> <p>• System accounting package (Records some usage data)</p>	<p>ADPE Resources</p> <p>Processor:</p> <p>Storage:</p> <p>Print:</p> <p>Terminal:</p> <p>Memory:</p> <p>Processing:</p> <p>Other Systems:</p>	<p>Software Functions</p> <p>• System usage accounting</p> <p>• System performance measurement</p> <p>• Report generation</p> <p>• On-line system monitor</p>
<p>Personnel Resources</p>		<p>Constraints or Limitations</p>		<p>Personnel Resources</p>

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: Software Analysis	System: U1108	Projected Life: Continuous	User/Contact: HARRAH/BOB Wade 18 Dec 80
Description of Function: This requirement should provide the capability to provide syntactic (correctness) and semantic (optimization) analysis of software generated in HMR.		Frequency of Function: This would be an ad hoc function.	
Current Support Partially			
ADPE Resources	Software Functions	ADPE Resources	Software Functions
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	* Semantic analyzer for assembly language	Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	* Language translators (Required to develop meta language if general purpose analyzers are used.) * Syntactic analyzers * Semantic analyzers
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function: Emulation	System: U1108	Projected Life: Continuous	User/Contact: HARRIS/Bob Wade	18 Dec 80
Description of Function: This requirement should provide the capability to emulate any MCR processor for software debug.		Frequency of Function: This is an ad hoc function.		
Current Support		Projected Requirements		
ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions	ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • System emulation (micro-programmable) • Emulator compilation	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function: User Cost Accounting	System: U1108	Projected Life: Continuous	User/Contact: MEZAH/BOB Wade	18 Dec 80
Description of Function: There is a requirement for internal planning purposes to establish a cost accrual and estimation system. It will be mandatory to support FMS cases. Costs must be accrued by project, individual, system, and budgetary source.		Frequency of Function: This is a periodic function, period to be determined.		
Current Support		Projected Requirements		
ADPE Resources	Software Functions	ADPE Resources	Software Functions	
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	• Data base creation • Manpower cost reporting • Consumables cost reporting • Facilities usage reporting • Capital acquisition reporting • Equipment usage reporting • Support processor usage reporting	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS			
Required ADP Function: Program Support Library	System: U1108	Projected Life: Continuous	User/Contact: HERRAH/Bob Wade 18 Dec 80
Description of Function: The capability would provide a central archive and library for current software, test data, and scenarios.		Frequency of Function: This would be a continuing function.	
Current Support			
ADPE Resources	Software Functions	ADPE Resources	Software Functions
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	• System cataloging • File editing, archiving, and identification • Data access • .. text • .. code • .. data • File transfer
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function: Automated Calendar	System: U1108	Projected Life: Continuous	User/Contact: MIRRAH/Bob Wade	18 Dec 80
Description of Function: The required capability should provide for establishment and notification of milestone dates and suspense items and threshold and exception conditions. It should provide automated notification by individual of impending milestones or suspense items.		Frequency of Function: This function is initiated by ad hoc entry of a milestone or suspense item and date. Subsequent monitoring is periodic.		
Current Support		Projected Requirements		
ADPE Resources	Software Functions	ADPE Resources	Software Functions	
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	<ul style="list-style-type: none"> Milestone/suspense item entry Status modification Date comparison and threshold/exception reporting 	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

*If CRT notification is used, extensive terminal facilities will be required.

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function: Provisioning	System:	Projected Life: Continuous	User/Contact: HARRIS/NOVA Owens	19 Dec 80
Description of Function: Desired capability is to retrieve provisioning factors and other provisioning data, i.e., security code, SNR code or MIEC code, by CRT, rather than from hard copy.		Frequency of Function: This is an ad hoc function.		
Current Support		Projected Requirements		
ADPE Resources	Software Functions	ADPE Resources	Software Functions	
Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:		Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	• Provisioning data base creation • Data base maintenance • Interactive inquiry	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function: Releasable Items Reference	System:	Projected Life: Continuous	User/Contact: HMIRS/Norm Owens	19 Dec 80
Description of Function: Desired capability would automate list of items and technical orders releasable to foreign nationals or contractors.		Frequency of Function: This is an ad hoc function.		
Current Support		Projected Requirements		
ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions 	ADPE Resources Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	Software Functions • Release data base creation • Data base maintenance • Interactive inquiry	
Personnel Resources 	Constraints or Limitations 	Personnel Resources 	Constraints or Limitations 	

ADP REQUIREMENTS SPECIFICATIONS				
Required ADP Function:	System:	Projected Life:	User/Contact:	
Documentation Maintenance		Continuous	HEBBS/Norm Owens	19 Dec 80
Description of Function:		Frequency of Function:		
A capability is required to enter, edit, and produce reference documentation. This capability will require insertion, deletion, modification, tabulation, pagination, headings, footings, and text search capability.		This is a continuing function.		
Current Support		Projected Requirements		
ADPE Resources	Software Functions	ADPE Resources	Software Functions	
Processor: U1108 Storage: Print: Terminal: Memory: Processing: Other Systems:	<ul style="list-style-type: none"> • Text editing • Document processor 	Processor: Storage: Print: Terminal: Memory: Processing: Other Systems:	<ul style="list-style-type: none"> • Text editing • Document processor 	
Personnel Resources	Constraints or Limitations	Personnel Resources	Constraints or Limitations	

APPENDIX B

COMPOSITE FUNCTIONAL REQUIREMENTS

This appendix presents the composite definitions of EWAISF Support Processor requirements, as described in Chapter Four and validated by the ISS Support Subcommittee.

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: Text/File Edit	Description of Function: A capability is required to enter, edit, duplicate, purge, and store program, data, and text files in character format. The capability should provide for maintenance of variable-length records.	
	Frequency of Function: This is an ad hoc engineering function required to support software change and test.	
Projected Requirements		
ADPE Requirements		Software Functions
Processor: Support Processor Storage: Mass storage as required; off-line back-up Terminal: Local to users		<ul style="list-style-type: none"> • Bulk data load • Text edit • File save/recall • File cataloging
Constraints or Limitations:		

Figure B-1. TEXT/FILE EDIT

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: Cross Compilation and Assembly Frequency of Function: This ad hoc engineering support for software assembly is used during the software change process (scheduled or emergency).	Description of Function: A cross compilation and assembly capability is required for target processors identified in Chapter Four, Table 4-1, and others as they are assigned or changed.	
Projected Requirements		
ADPE Requirements		Software Functions
Processor: Support Processor		<ul style="list-style-type: none"> • Program file maintenance • Cross assembly • Program transfer
Constraints or Limitations:		

Figure B-2. CROSS COMPILATION AND ASSEMBLY

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: Automatic Software Documentation	Description of Function: A capability is required to provide automatically generated software documentation during the assembly and binding processes.	
Frequency of Function: This function is performed when software is released.		
Projected Requirements		
ADPE Requirements		Software Functions
Processor: Support Processor Print: Local printer Other Systems: Graphics output		<ul style="list-style-type: none">• Memory map• Load map• Subroutine interface listing• Software flow chart• Document processor
Constraints or Limitations: Details of automated documentation functions may vary from processor to processor.		

Figure B-3. AUTOMATIC SOFTWARE DOCUMENTATION

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: Threat Data Base Maintenance	Description of Function: The capability must provide maintenance of the EWIR or other threat data bases and must extract, sort, and format threat data for use by other systems.	
	Frequency of Function: Maintenance is a monthly function. Extraction and sort are ad hoc functions performed when an EWOLS simulation is to be set up or when ECSS require parameter data.	
Projected Requirements		
ADPE Requirements		Software Functions
Processor: Support Processor Other Systems: Direct interface to ISS host processor desirable for data transfer		<ul style="list-style-type: none"> • Data base structuring • Data entry, addition, deletion, and change • Threat data extraction and sorting • Output formatting
Constraints or Limitations:		

Figure B-4. THREAT DATA BASE MAINTENANCE

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: Data Reduction/Analysis	Description of Function: The required capability must allow input of data from ISS or flight test (including pod-recorded data) and generalized correlation of the data	
Frequency of Function: This is an ad hoc function performed in conjunction with system test.		
Projected Requirements		
ADPE Requirements	Software Functions	
Other Systems: Might require external interface with flight test data system (tape)	<ul style="list-style-type: none">• ISS interface (tape or direct)• Flight test system interface (tape or direct)• Data base structure• Data base maintenance - entry, deletion, change• Data base extraction and sorting• Generalized statistical functions• Output report formatting• Ground data correlation	
Constraints or Limitations:		

Figure B-5. DATA REDUCTION/ANALYSIS

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: Validation and Verification (V&V) Test Support	Description of Function: The requirement is to provide software test tools to support software V&V. These may be general or specific to target processors.	
Frequency of Function: These would be ad hoc functions.		
Projected Requirements		
ADPE Requirements		Software Functions
		<ul style="list-style-type: none">• Test data generators• General-purpose translators• Smart editors
Constraints or Limitations: Definition of these test tools is currently under way. Details may depend on schedules of transitioning software.		

Figure B-6. VALIDATION AND VERIFICATION (V&V) TEST SUPPORT

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: Change Distribution	Description of Function: The required capability is to provide an automated medium for distribution of software changes to the field.	
Frequency of Function: This function is performed whenever a software change is released to the field.		
Projected Requirements		
ADPE Requirements		Software Functions
Processor: Support Processor Other Systems: Magnetic tape output device		AUTODIN tape formatting
Constraints or Limitations: Field distribution media may be subject to change.		

Figure B-7. CHANGE DISTRIBUTION

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: Data Table Generation	Description of Function: The requirement is to provide the capability to output messages for field updates to data tables.	
Frequency of Function: This is an ad hoc function, as required by threat changes.		
Projected Requirements		
ADPE Requirements	Software Functions	
Other Systems: Binary Tape Output Device	<ul style="list-style-type: none">• EIC extraction and data formatting• Table generation/formatting• Binary tape device driver	
Constraints or Limitations:		

Figure B-8. DATA TABLE GENERATION

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: Software Tools Compilation	Description of Function: The required capability should provide high-order language (HOL) and assemblers to permit development of support software packages.	
Frequency of Function: This is an ad hoc function.		
Projected Requirements		
ADPE Requirements	Software Functions	
Processor: Support Processor	Compilers -- FORTRAN, COBOL, Ada, JOVIAL J73, Pascal, and FORTH	
Constraints or Limitations:		

Figure B-9. SOFTWARE TOOLS COMPILATION

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: ECS and ISS Documentation Maintenance	Description of Function: A capability to enter, edit, and produce system documentation is required, including the capability to insert, delete, modify, tabulate, paginate, search the text, and provide headers and footings.	
Frequency of Function: This is an ad hoc function that occurs when software is changed.		
Projected Requirements		
ADPE Requirements	Software Functions	
Processor: Support Processor Print: Local printers Terminal: Local to systems	<ul style="list-style-type: none">• Text editor• Document processor	
Constraints or Limitations: Personnel required for document entry and editing.		

Figure B-10. ECS AND ISS DOCUMENTATION MAINTENANCE

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: ISS Configuration Management	Description of Function: The requirement must provide maintenance and monitoring of ISS hardware configurations (e.g., ISS wirelists) and provide engineering drawings for layouts and wire runs.	
	Frequency of Function: This is an ad hoc function to be performed when the ISS configuration changes.	
Projected Requirements		
ADPE Requirements		Software Functions
Processor: Support Processor Other Systems: Potential use of plotter graphics		<ul style="list-style-type: none"> • Data base structuring • Data base conversion • Wirelist updating • Wirelist printing
Constraints or Limitations:		

Figure B-11. ISS CONFIGURATION MANAGEMENT

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: Training	Description of Function: The required capability would provide interactive, programmed instruction in the use of the support processor and HOLs, and in ISS programming, use, and operating instructions.	
Frequency of Function: This function would occur on an ad hoc basis for each new system user.		
Projected Requirements		
ADPE Requirements	Software Functions	
Processor: Support Processor Terminal: Training terminals	<ul style="list-style-type: none">• Training identification and separation• Programmed instruction	
Constraints or Limitations: <ul style="list-style-type: none">• Must isolate training functions from operational functions• Must satisfy security aspects of training• Requires development of programmed courses of instruction		

Figure B-12. TRAINING

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: Software Code Analysis	Description of Function: This function should provide the capability of syntactic and semantic analysis and optimization of software.	
Frequency of Function: This would be an ad hoc function.		
Projected Requirements		
ADPE Requirements	Software Functions	
Processor: Support Processor	<ul style="list-style-type: none">• Language translators (required to develop meta language if general-purpose analyzers are used)• Syntactic analyzer(s)• Semantic analyzer(s)• Languages<ul style="list-style-type: none">•• Pascal •• COBOL•• Ada •• APL•• JOVIAL J73 •• FORTH•• FORTRAN IV	
Constraints or Limitations:		

Figure B-13. SOFTWARE CODE ANALYSIS

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: Software Performance Analysis	Description of Function: The requirement is to provide a capability to analyze software implementation to determine choke points, frequency-of-code execution, instruction timings, and other performance parameters in order to fine tune the software in response to changing requirements.	
Frequency of Function: This is an ad hoc function.		
Projected Requirements		
ADPE Requirements	Software Functions	
Processor: Support Processor Other Systems: May involve ISS software for data collection	<ul style="list-style-type: none">• Software execution data collection• Software data correlation• Statistics report generation	
Constraints or Limitations:		

Figure B-14. SOFTWARE PERFORMANCE ANALYSIS

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: Software Conversion Support	Description of Function: The required capability should provide for syntactic analysis and translation of software languages for conversion of ISS or support processors.	
	Frequency of Function: As required to support processor conversions.	
Projected Requirements		
ADPE Requirements		Software Functions
Processor: Support Processor		<ul style="list-style-type: none"> • Syntax comparators • Translators
Constraints or Limitations:		

Figure B-15. SOFTWARE CONVERSION SUPPORT

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: Program Support Library	Description of Function: The capability would provide a central archive and library for current software, test data, and scenarios.	
Frequency of Function: This would be a continuing function.		
Projected Requirements		
ADPE Requirements	Software Functions	
Processor: Support Processor Other Systems: Data link to ISS host processors	<ul style="list-style-type: none">• System cataloging• File editing, archiving, identification, and cross-referencing• Data access<ul style="list-style-type: none">•• Text•• Code•• Data• File transfer	
Constraints or Limitations:		

Figure B-16. PROGRAM SUPPORT LIBRARY

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: Software Archive	Description of Function: The required capability is to provide a back-up software archive and data management function.	
Frequency of Function: This would be a periodic function; periodicity to be determined.		
Projected Requirements		
ADPE Requirements	Software Functions	
Processor: Support Processor	<ul style="list-style-type: none">• Transfer and store software from host computer to support processor• Retrieve and restore software as required• Catalog and index software versions by system, function, version, and date	
Constraints or Limitations: <ul style="list-style-type: none">• Should provide separate facility for storage to avoid catastrophic loss• Requires personnel to administer and control archive process		

Figure B-17. SOFTWARE ARCHIVE

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: Project Control	Description of Function: The required capability must provide for monitoring assigned section projects, including tracking milestones and dates and monitoring resource assignments. The capability should permit planning and analysis, e.g., PERT or critical path modeling. It should also provide the ability to produce graphic representations of the project schedules.	
Frequency of Function: This is a continuous function performed for each assigned project.		
Projected Requirements		
ADPE Requirements		Software Functions
Print: Local Printer Capability Terminal: Local to users		<ul style="list-style-type: none">• Data base maintenance (creation and update)• Data extraction and sorting• Activity network analysis• Plotter support• Exception report generation
Constraints or Limitations:		

Figure B-18. PROJECT CONTROL

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: Configuration Management	Description of Function: This requirement should provide for automated support of the configuration management process, including: <ul style="list-style-type: none">• ECP initiation and tracking• Suspense management• CPCSB agenda development• Block-style reporting	
Frequency of Function: This is a continuing function.		
Projected Requirements		
ADPE Requirements	Software Functions	
Terminal: Terminal capability for all SP and CPCSB members*	<ul style="list-style-type: none">• ECP identification and distribution• Suspense establishment• Suspense threshold reporting• ECP status reporting• ECP status update and approval monitoring• Configuration/effectivity analysis• Configuration status accounting• CPCSB agenda development• Block-style tracking	
*SP - Screening panel; CPCSB - Computer program configuration subboard.		
Constraints or Limitations:		

Figure B-19. CONFIGURATION MANAGEMENT

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: Document Control	Description of Function: This capability is required to identify, catalog, and locate system documentation.	
	Frequency of Function: This is an ad hoc function performed when there is a change in documentation content or status.	
Projected Requirements		
ADPE Requirements		Software Functions
Processor: Support Processor Terminal: Local to users		<ul style="list-style-type: none"> • Documentation data base maintenance • Document status report generation
Constraints or Limitations: Requires personnel for entering data.		

Figure B-20. DOCUMENT CONTROL

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: Security	Description of Function: The capability is required to provide requisite data, and operational and environmental security for support processor operations, in full compliance with DoD and Air Force security regulations and instructions for systems operating in the system high mode, or in such modes as designated in the future.	
Frequency of Function: This is a continuous function for duration of support processor life cycle.		
Projected Requirements		
ADPE Requirements	Software Functions	
<ul style="list-style-type: none">• All hardware must satisfy TEMPEST requirements in the operational environment.• Communications between devices that are not in the same secure area must be protected in accordance with regulations.	<ul style="list-style-type: none">• System and function access control• Data access control• Program and data cross-talk isolation• Mass storage and output classification• Data purge	
Constraints or Limitations:		

Figure 3-21. SECURITY

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: System Management	Description of Function: The requirement exists (1) to determine system usage by EW system, user, and individual; (2) to monitor system performance (e.g., I/O wait times, memory allocations, throughput); and (3) to analyze usage to determine growth and enhancement requirements.	
	Frequency of Function: This is a continuing function.	
Projected Requirements		
ADPE Requirements		Software Functions
		<ul style="list-style-type: none"> • System usage accounting • System performance measurement • Report generation • On-line system monitoring
Constraints or Limitations:		

Figure B-22. SYSTEM MANAGEMENT

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: User Cost Accounting	Description of Function: There is a requirement for internal planning purposes to establish a cost accrual and estimating system. It will be mandatory to support FMS cases. Costs must be accrued by project, individual, system, and budgetary sources.	
	Frequency of Function: This is a periodic function; periodicity to be determined.	
Projected Requirements		
ADPE Requirements		Software Functions
Processor: Support Processor		<ul style="list-style-type: none"> • Data base creation • Manpower cost reporting • Consumables cost reporting • Facilities usage reporting • Capital acquisition reporting • Cost-accrual algorithm(s)
Constraints or Limitations: Must provide separate cost accrual for FMS cases.		

Figure B-23. USER COST ACCOUNTING

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: On-Line Simulation	Description of Function: This required capability would provide for on-line digital environment simulation (1) to provide an operating environment for processor emulations, and (2) to provide a test environment in the event of unavailability of RF test equipment or portions of the hot bench mock-up.	
	Frequency of Function: These are ad hoc functions.	
Projected Requirements		
ADPE Requirements		Software Functions
Processor: Support Processor Other Systems: Requirement(s) would require direct link to ISS		<ul style="list-style-type: none"> • System interface (e.g., bus, channel) • Scenario processor • Digital-level simulator • Output capture
Constraints or Limitations: would require either a complex, general-purpose simulation or a simulation for each system.		

Figure B-24. ON-LINE SIMULATION

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: V&V Tracking	Description of Function: A capability is required to track changes for V&V. This capability should provide change traceability for test-tracking purposes.	
Frequency of Function: This is an ad hoc function performed in conjunction with an emergency or cyclic update.		
Projected Requirements		
ADPE Requirements	Software Functions	
Processor: Support Processor	<ul style="list-style-type: none">• Data base structuring• Data base maintenance (add, delete, change)• Data inquiry and output formatting	
Constraints or Limitations:		

Figure B-25. V&V TRACKING

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: Emulation	Description of Function: This requirement should provide the capability to emulate ECS and ISS processors for software debug.	
Frequency of Function: This is an ad hoc function.		
Projected Requirements		
ADPE Requirements		Software Functions
Processor: Support Processor Other Systems: (See Constraints)		<ul style="list-style-type: none">• System emulation (microprogrammable)• Emulator compilation
Constraints or Limitations: Potential for use on ISS host processors if microprogrammable.		

Figure B-26. EMULATION

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: System Modeling	Description of Function: The required capability would permit off-line simulation of system design and functions for evaluating design and software implementations.	
Frequency of Function: This is an ad hoc function.		
Projected Requirements		
ADPE Requirements	Software Functions	
Processor: Support Processor	<ul style="list-style-type: none"> • System model (level undetermined) • Software model • External interface models 	
Constraints or Limitations:		

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: Budget Preparation	Description of Function: This function would provide automated maintenance of the program budget data base, creation of budgetary submissions, and consolidation of data for all budget sources.	
	Frequency of Function: This would be a periodic function to be aligned with the annual budget cycle.	
Projected Requirements		
ADPE Requirements Process: Support Processor Terminal: Local to MMRM		Software Functions <ul style="list-style-type: none"> • Budget data base creation • Budget data base maintenance • Budget submission report generation
Constraints or Limitations:		

Figure B-28. BUDGET PREPARATION

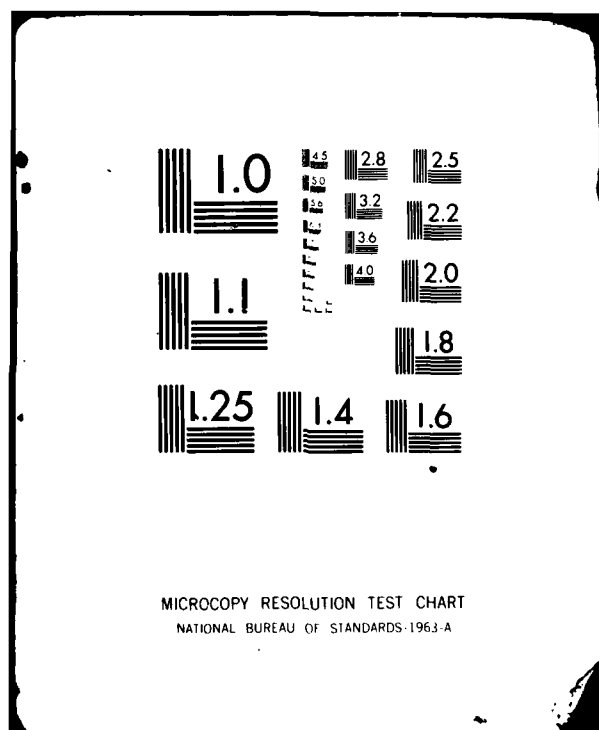
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COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: Life-Cycle-Cost Analysis	Description of Function: This requirement would provide a model for projecting system life-cycle costs on the basis of varying support concepts, changes in programs and equipments, and changes in requirements parameters.	
	Frequency of Function: This would be an ad hoc function.	
Projected Requirements		
ADPE Requirements Processor: Support Processor		Software Functions <ul style="list-style-type: none"> • Cost factors data base creation • Cost factors data base maintenance • Life-cycle-cost modeling • NRE-to-date reporting • Investment cost-to-date reporting • O&S cost-to-date reporting
Constraints or Limitations:		

Figure B-29. LIFE-CYCLE-COST ANALYSIS

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: Procurement Preparation	Description of Function: This requirement would provide for automated support to the Contract Data Requirements List (CDRL) development. Standard packages of data item descriptions would be developed and maintained for selection, modification, or inclusion in the procurement package.	
	Frequency of Function: This would be an ad hoc function.	
Projected Requirements		
ADPE Requirements		Software Functions
Processor: Support Processor		<ul style="list-style-type: none"> • Development of CDRL data base • Update of CDRL data base • Retrieval and printing of CDRL packages
Constraints or Limitations:		

Figure B-30. PROCUREMENT PREPARATION

COMPOSITE REQUIREMENTS SPECIFICATION		
Required Function: Checkbook	Description of Function: The requirement is to provide MMR personnel with budgetary "checkbooks" to account for funds status by source, type, recipient, and purpose, and to provide an audit trail of budgetary actions.	
Frequency of Function: This is a periodic function; periodicity to be determined.		
Projected Requirements		
ADPE Requirements Processor: Support Terminal: Local to users		Software Functions <ul style="list-style-type: none"> • Budget establishment • Budget maintenance • Funding action entry • Checkbook resolution • Funding status report generation
Constraints or Limitations:		

Figure B-31. CHECKBOOK

APPENDIX C

FINANCIAL BASIS FOR COST ESTIMATES

This appendix contains financial tables used to develop cost estimates. Table C-1 presents the composite pay rates (as of 1 October 1980) used to develop estimates of operation and labor software development. Table C-2 presents discount factors used to obtain present values of annual project costs. The discount factors are based on continuous compounding of interest at the stated effective rate per annum, assuming uniform cash flows throughout stated one-year periods. These factors are equivalent to an arithmetic average of beginning and end-of-the-year compound amount factors found in standard present-value tables.

Table C-1. COMPOSITE PAY RATES		
General Schedule	1980*	1981*
GS-01	8,281	9,035
GS-02	9,434	10,292
GS-03	10,983	11,933
GS-04	12,701	13,857
GS-05	14,732	16,073
GS-06	16,741	18,264
GS-07	18,184	19,839
GS-08	20,786	22,678
GS-09	22,246	24,270
GS-10	25,195	27,478
GS-11	26,880	29,326
GS-12	32,183	35,112
GS-13	39,066	42,621
GS-14	46,173	50,375
GS-15	53,714	56,802
GS-16	56,802	56,802
GS-17	56,802	56,802
GS-18	56,802	56,802
*Executive limit to basic pay for employees is \$50,112.50.		

**Table C-2. PROGRAM/PROJECT
YEAR DISCOUNT
FACTORS**

Project Year	Present Value of \$1 at 10% Discount
1	0.954
2	0.867
3	0.788
4	0.717
5	0.652
6	0.592
7	0.538
8	0.489
9	0.445
10	0.405
11	0.368
12	0.334
13	0.304
14	0.276
15	0.251
16	0.228
17	0.208
18	0.189
19	0.172
20	0.156
21	0.142
22	0.219
23	0.117
24	0.107
25	0.097

APPENDIX D

PRICE QUOTATIONS

Tables D-1, D-2, and D-3 present the representative price quotations used to develop equipment cost estimates for the three EWALSF support processor architectures. These quotations form the basis of the equipment cost summaries presented in the cost-benefit analysis.

Some slight modification was necessary to make these estimates conform comparably to both the basic and enhanced versions of each architecture. For instance, the quotation received for the single-processor architecture does not include the emulator enhancement. Accordingly, the purchase price of \$279,100 and the monthly maintenance cost of \$1,372 for the emulation option (as defined in Option 2) were added to the basic quotation of Option 1 to yield an estimate of the enhanced version.

The quotation received for the multiple processor includes the emulator option. Accordingly, the purchase price of \$279,100 and the monthly maintenance cost of \$1,372 were deducted from the quotation to estimate equipment and maintenance costs of Option 2. The same procedure was applied to Option 3 (multiple processors with front-end processor).

Table D-1. PRICE QUOTATIONS FOR OPTION 1: SINGLE-PROCESSOR ARCHITECTURE (IN DOLLARS)

Quantity	Equipment Description	Monthly Maintenance Cost	Purchase Price	Total Cost
1	1091-SC KL10-E CPU MCA20 Cache 2' RH20 256 KW Mos Memory (1.25 Megabytes) 1 RP06 176 MB Disk Drive LA120 16 Asynchronous Lines Initial Support Package	2,074	476,000	476,000
2	RH20 Internal Channel DSMC @ \$34	68	15,000	30,000
12	RP06-AA 176 MB Disk Drive DSMC @ \$250	3,000	34,000	408,000
1	TX02-EH Tape Controller and DX20 Channel	595	96,800	96,800
2	TU71 7 Track 800/1600 BPI 20 IPS Tape Drive DSMC @ \$325	650	50,000	100,000
1	TU77-CB Master 800/1600 BPI 125 IPS Tape Drive	309	34,800	34,800
3	TU77-AF 9 Track 800/1600 BPI 125 IPS Add-On DSMC @ \$230	690	23,100	69,300
2	LP200-BA 120 LPM Printer DSMC @ \$505	1,010	54,000	108,000
2	LP07-YA 64 Character Band for LP200 Printer	N/A	4,300	8,600
3	VT100-DA 16 Pack VT100-AA CRT	368	25,000	75,000
2	VT100-AA CRT Terminals DSMC @ \$23	46	2,150	4,300
50	BC03M-25, 25-Foot Null Modem Cable	N/A	70	3,500
1	QH101-AP DBMS-10 MT9, 800 (includes 2 training credits)	730	34,500	34,500
1	QH500-XP Cobol 68/74 and SIM, MT9, 800	285	11,500	11,500
1	QH099-XP Cobol 68/74 and SIM, MT9, 800	390	15,000	15,000
1	LXY11 300 LPM Printer/Plotter (RS232 Connection)	134	12,600	12,600
Total		10,349		1,487,900

Table D-2. PRICE QUOTATIONS FOR OPTION 2: MULTIPLE-PROCESSOR ARCHITECTURE (IN DOLLARS)

Quantity	Equipment Description	Monthly Maintenance Cost	Purchase Price	Total Cost
1	SV-AXVCA-CA 11/780 CPU 2 MB Memory REP07-AA 512 MB Disk and Controller TEU78-AB 1600/6250 125 IPS Tape Drive H9602-DF Unibus Option Cabinet BALL-KE Exp Box 5 SU DD11-DK Two SU Backplane DZ11-A 8 Line EIA Interface QE001-AM VAX/VMS Operating System	1,372	288,500	288,500
2	SV-AXVCA-CK 11/780 2 MB Memory REP07-AA 512 MB Disk and Controller TEU78-AB 1600/6250 125 IPS Tape Drive H9602-DF Unibus Option Cabinet BALL-KE Expansion Box 5 SU DD11-DK Two SU Backplane DZ11-A 8 Line EIA Interface QE001-DZ VAX/VMS Operating System License Only BMC @ \$1,372	2,744	279,100	558,200
3	RP07-C Dual Access Kit BMC @ \$20	60	5,150	15,450
1	RP07-BA RP07 3-Phase Dual Access BMC @ \$200	200	43,140	43,140
2	LP100-BA 1200 LPM Character Band Printer BMC @ \$404	808	63,100	126,200
2	LP07-YA 64/64 Character Band for LP100	N/A	4,300	8,600
2	DZ11-B 8 Line Expansion Multiplexer for DZ11-A BMC @ \$27	54	2,050	4,100
4	DZ11-E 16 Line Multiplexer BMC @ \$53	212	4,300	17,200

(continued)

Table D-2. (continued)				
Quantity	Equipment Description	Monthly Maintenance Cost	Purchase Price	Total Cost
3	FP780-AA Floating Point Accelerator 11/780 BMC @ \$48	144	10,600	31,800
1	TU78-AB 1600/6250 Tape BMC @ \$170	170	25,500	25,500
4	TM78-C Dual Access Kit for TU78 Tape Drive BMC @ \$20	80	5,150	20,600
3	VT100-DA Pack of 16 VT100-AA BMC @ \$288	864	25,000	75,000
2	VT100-AA BMC @ \$18	36	2,150	4,300
50	BC03M-25, 25-Foot Null Modem Cables	N/C	70	3,500
1	QE100-AY VAX-11 Fortran	40	8,050	8,050
1	QE099-AY VAX-11 Cobol	40	13,800	13,800
2	QE100-DZ VAX-11 Fortran License Only	N/A	4,490	8,980
2	QE099-DZ VAX-11 Cobol License Only	N/A	7,590	15,180
3	PCL11-B Multiple CPU Link BMC @ \$63	189	7,750	23,250
Total		7,013		1,291,350

Table D-3. OPTION 3: PRICE QUOTATIONS FOR FRONT-END/
MULTIPLE PROCESSOR ARCHITECTURE (IN DOLLARS)

Quantity	Equipment Description	Monthly Maintenance Cost	Purchase Price	Total Cost
1	XV-AXVCA-CA 11/780 CPU 2 MB Memory REP07-AA 512 MB Disk and Controller TEU78-AB 1600/6250 BPI 125 IPS Tape Drive H9602-DF Unibus Option Cabinet BA11-KE Expansion Box 5 SU DD11-DK Two SU Backplane D211-A 8 Line EIA Interface QE001-AM VAX/VMS Operating System	1,372	288,500	288,500
2	SV-AXVCA-CK 11/780 2 MB Memory REP07-AA 512 MB Disk and Controller TEU78-AB 1600/6250 125 IPS Tape Drive H9602-DF Unibus Option Cabinet BA11-KE Expansion Box 5 SU DD11-DK Two SU Backplane D211-A 8 Line EIA Interface QE001-DZ License Only VAX/VMS BMC @ \$1,372	2,744	279,100	558,200
1	SM-40MMA-CA 11/44 CPU 256 KB Mos Memory H9642 Cabinet with Dual TU58 RL211-AK 10 MB Disk and Controller LA120 DECwriter Console Terminal RL02-AK 10M Disk QJ738 RSX-11M	302	52,000	52,000
3	SM-40MMA-CK 11/44 CPU 256 KB Mos Memory H9642 CAB with Dual TU58 RL211-AK 10 MB Disk and Controller LA120 DECwriter Console Terminal RL02-AK 10M Disk Q5738 RSX-11M License Only BMC @ \$302	906	47,000	141,000
4	D211-E 16 Line Multiplexer (EIA) BMC @ \$27	108	4,300	17,200
3	VT100-DA Pack of 16 VT100-AA BMC @ \$288	864	25,000	75,000
48	BC03M-25, 25-Foot Null Modem Cable	N/C	70	3,360
3	RP07 Dual Access Kit BMC @ \$20	60	5,150	15,450

(continued)

Table D-3. (continued)

Quantity	Equipment Description	Monthly Maintenance Cost	Purchase Price	Total Cost
1	RP07-BA Dual-Access 3-Phase 512 MB Formatted Disk Drive	200	43,140	43,140
2	LP100-BA 1200 LPM Character Band BMC @ \$404	808	63,100	126,200
2	LP07-YA 64/64 Character Band for LP100 Printer	N/A	4,300	8,600
3	FP780-AA Floating Point Accelerator 11/780 BMC @ \$48	144	10,600	31,800
1	TU78-AF 1600/6250 BPI Tape Drive	170	25,500	25,500
4	TM78-C TU78 Dual Access Kit BMC @ \$20	80	5,150	20,600
3	LXY11-AD 300 LPM Printer/Plotter BMC @ \$134	402	12,600	37,800
10	DMR11-AC 56 KB - 1 MB Local Link BMC @ \$37	370	4,200	42,000
5	DD11-DK 2 Quad 7 Hex Backplane	N/C	900	4,500
6	BC55M-98 98 FR Triax Amp DMR11 Local	N/C	155	930
1	QE100-AY VAX-11 Fortran	40	8,050	8,050
2	QE100 DZ VAX-11 Fortran License Only	N/A	4,490	8,980
1	QE099-AY VAX-11 Cobol	40	13,800	13,800
2	QE099-DZ VAX-11 Cobol License Only	N/A	7,590	15,180
Total		8,610		1,537,790

APPENDIX E

PERFORMANCE SIMULATION

The system performance results reported in Chapter Six are based on a simulation model developed for this study. This appendix describes the logic and operation of the performance simulator summarized in the report.

MODEL OVERVIEW

Figure E-1 is an overall schematic for the performance simulator, which shows that performance simulation consists of four major activities:

- Define job parameters
- Define run parameters
- Calculate run requirements
- Present the job stream to the system

This sequence of activities applies to each individual job and also to the simulation as a whole. In both cases, simulation begins by defining job parameters, e.g., instructions, number of iterations. The next step is to convert these job characteristics into run parameters, which define the actual workload for the processor.

Given the run parameters for a job, the next step is to calculate run requirements, accomplished by combining run parameters (e.g., number of executed instructions) with the processor's capabilities, such as instruction execution rate. These calculations yield the execution time, I-O time, and main memory requirement for each job. The final step of the simulation is to present the job or job stream to the simulated processor and compute the results.

Each of these major elements of performance simulations consists of a series of detailed definitions, rules, and calculations. The nature of these details and their implementation in the performance simulator are discussed in the following paragraphs.

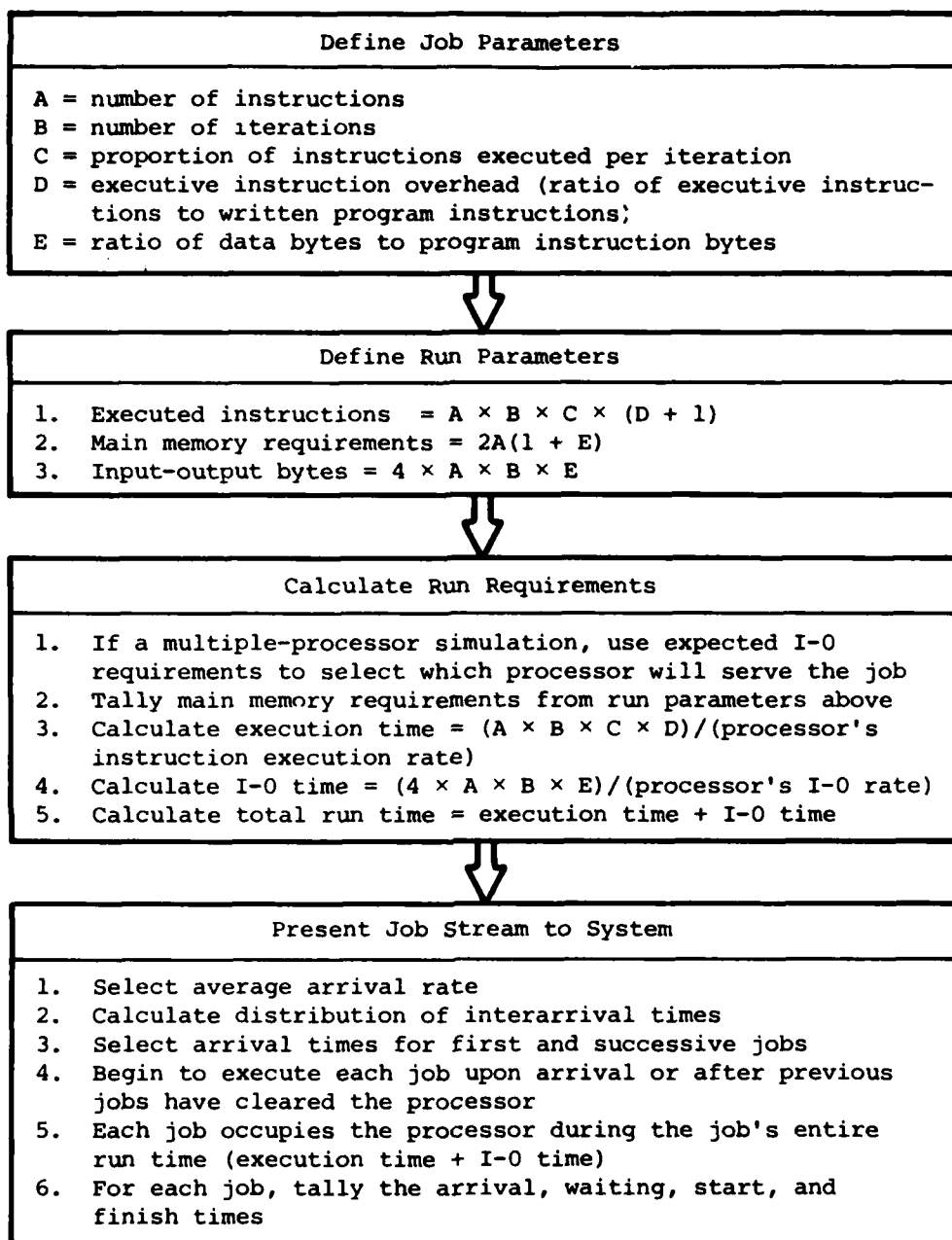


Figure E-1. GENERAL SCHEMATIC FOR PERFORMANCE SIMULATION

DEFINE JOB PARAMETERS

The job parameters chosen to describe each job were selected because they are the fundamental characteristics that determine computer resource requirements. They are also the parameters used for architectural sizing

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in the requirements analysis. There are five basic job parameters of concern:

- Number of instructions
- Number of iterations
- Proportion of instructions executed per iteration
- Executive instruction overhead (ratio of executive instructions to written program instructions)
- Ratio of data bytes to program instruction bytes

During the requirements analysis, typical values for these parameters were developed, validated, and then used for architecture sizing. These typical or average values were as follows:

- 5,000 instructions
- 25 iterations
- 0.5 (50 percent) of instructions executed per iteration
- 0.25 executive instruction overhead
- 10 data bytes per program byte

Although these parameter values may, in fact, typify the future job stream, we cannot reasonably expect all jobs to be identical. It is also possible that future job streams may drift or depart from these averages. Therefore, the simulation permits variation around these averages.

This variation is introduced into the performance simulator by making what is called a "minimum information" assumption. That is, in the absence of other information, it is assumed that each outcome of each parameter is equally likely. This assumption leads to two results:

- Each value of each parameter for each job in the simulation is drawn from a uniform (or rectangular) probability distribution.
- The maximum value of each parameter is twice its average.

Thus, after truncating slightly at the lower end to avoid trivial jobs, the following parameter ranges result:

- 1,000 to 10,000 instructions
- 1 to 50 iterations
- 0.1 to 1.0 of instructions executed per iteration
- 0.0 to 0.5 executive instruction overhead
- 1 to 20 data bytes per program instruction byte

These are the parameter-value ranges from within which values are chosen randomly to define job parameters for each job in the simulation.

There is one exception to this general method of generating job parameters. The exception concerns emulation runs, which are generated separately as intensive computation applications. Emulation job characteristics assumed for this performance simulation are as follows:

- 10,000 instructions
- 1,000 iterations
- 1.0 (100 percent) of instructions executed per iteration
- 0.5 executive instruction overhead
- 1 data byte per program instruction byte

DEFINE RUN PARAMETERS

The next major step in performance simulation is to translate job parameters into run parameters: executed instructions, main memory requirements, and I-O bytes. This translation is accomplished by the following formulas:

Executed instructions = (number of instructions) × (number of iterations) × (proportion of instructions executed per iteration) × (1 + executive instruction overhead ratio)

Main memory requirements = 2 × (number of instructions) × (1 + ratio of data bytes to program instruction bytes)

Input-output bytes = 4 × (number of instructions) × (number of iterations) × (ratio of data bytes to program instruction bytes)

The formula for executed instructions is self-explanatory. However, some assumptions require explanation regarding the derivations of main memory requirements and input-output bytes.

Main memory requirements are driven primarily by the number of instructions and the ratio of data bytes to program-instruction bytes. It is assumed that each instruction requires 2 bytes of main memory. This value is chosen as being representative of the various processors suitable for this application and is the source of the "2" in the main memory requirement equation.

Input-output bytes refer to the total number of data bytes transferred between mass memory and the processor during program execution. It is assumed that this transfer occurs twice during each iteration. At the start of the iteration, transfer occurs from mass memory to the processor; at the end of the iteration, the processor returns the processed data to mass memory.

The single exception to this input-output calculation occurs for emulation runs, which are viewed as being especially computation-intensive. This focus is reflected in a reduced input-output data flow. Specifically, one transfer is assumed to occur at the start from mass memory to processor, and another transfer from processor to mass memory is assumed at the end of the run. Intervening iterations rely solely on the results of the previous calculations.

CALCULATING RUN REQUIREMENTS

The performance simulator determines three major run requirements: main memory bytes, execution time, and I-O time.

Main memory requirements are simply carried over intact from the above run parameter calculations. For these simulations, main memory proves not to be a governing constraint, given the job parameters and processor parameters. Therefore, the main memory requirement is not treated further.

Execution time is calculated by dividing the number of executed instructions by the instruction execution rate for the processor. I-O time is calculated by dividing the total I-O bytes by the I-O transfer rate. Total run time is the sum of execution time and I-O time.

The processor rates used for these simulations are as follows:

<u>System</u>	<u>Instruction Execution Rate</u>	<u>I-O Transfer Rate</u>
Single processor	500 kips*	1,500 kbps**
Computation processor	250 kips	500 kbps
Data processor	250 kips	1,000 kbps

The overall execution and I-O rates were chosen as representing the capability envisioned in the requirements analysis portion of this study. For the multiple-processor option, this capability was, as a first approximation, simply divided between the processors. Detailed design might provide more refined or, possibly, dynamic allocations of this capability.

PRESENTING THE JOB STREAM TO THE SYSTEM

The preceding steps of the performance simulation generate basic job parameters, translate the job parameters to run parameters, calculate run requirements, and finally yield an overall run time for each run.

*kips = thousands of instructions per second.
**kbps = kilobytes per second.

The next major step of the simulation is to present the job stream to the system and then compute system performance. This part of the simulation consists of the following actions:

- Select average arrival rate
- Calculate distribution of interarrival times
- Select arrival times for first and successive jobs
- Begin to execute each job upon arrival or as soon as the previous job is completed
- For each job, tally the arrival, waiting, start, and finish times

The average arrival rates chosen for these simulations are 75, 150, 300, and 600 jobs per hour. These rates are chosen to bracket somewhere within them the actual future job stream. The upper end of the range is selected to reflect heavy workloads during recovery from downtime. An average arrival rate of 75 jobs per hour translates to an average interarrival time of 48 seconds; 150 jobs per hour to 24 seconds, 300 jobs per hour to 12 seconds, and 600 jobs per hour to 6 seconds.

The generation of actual arrival times from these averages follows the same minimum information procedure used to develop job parameters. Thus a mean interarrival time of 48 seconds implies that actual interarrival times were generated randomly, with each interarrival time being added to the arrival time of the preceding job.

As a simulation convention, a second is an interval of time in which events occur. By convention, a job is presumed to arrive at the processor at the beginning of a simulated second. A job leaves the processor at the end of a simulated second and entirely occupies the processor while executing. Therefore, the overall run times previously calculated are rounded up to the next whole second.

Data applications are distinguished from computation applications on the basis of factors governing I-O requirements. Aside from number of instructions, the main factors are number of iterations and the ratio of data bytes to instruction bytes. It is the product of these factors that determines a job's I-O bytes.

Accordingly, a job is judged to be a data application or computation application on the basis of the product of its number of iterations and ratio of data bytes to program instruction bytes. This product is compared with the product of average values of these parameters. An average of 25 iterations and 10 data bytes per program instruction byte is expected. Therefore, 250 is the threshold value used to distinguish between data and computation applications. Jobs whose product exceeds 250 are considered to be data applications, while jobs whose product is up to and including 250 are computation applications. The sole exception to this rule is an emulation run, whose product is 1,000 but is always treated as a computation application.

The above procedures create a simulated job stream and then simulate the serving of this job stream by the modeled architecture. The quality of this simulated service is measured by the average delay per job.

For reporting summaries of delays, the simulated jobs are treated as groups, such as "composite job stream arriving at a rate of 75 per hour and executed on the single processor." For each such group, average delay is calculated by

$$\text{Average delay} = \frac{\text{Sum of delays for all jobs in group}}{\text{Number of jobs in the group}}$$

It is these average delays that are reported in Chapter Six, Table 6-6. Comparisons among these delays are used to assess the relative performances of alternative architectures.

APPENDIX F

STUDY UPDATE PROCEDURE

INTRODUCTION

For a variety of reasons it may become necessary to update, revise, or extend the study described in this report. Likely reasons for updating include support of new EW systems, introduction of new support functions and new support concepts, or some combination of these events.

Regardless of the cause, a standard update procedure should be used to estimate the impact of new requirements. This procedure consists of five basic steps:

- Define new requirement
- Validate requirement
- Estimate hardware and software impact
- Estimate required changes to system architecture configuration
- Revise cost-benefit analysis

These five steps are summarized in the following sections.

DEFINE NEW REQUIREMENT

The new requirement must be defined in sufficient detail that it can be reviewed, approved, and used to develop quantitative estimates of effects on system configuration, costs, and benefits. That is, requirement definition must lead to measurable results. Sample hypothetical new requirements include:

- New reports or kinds of analyses for existing EW systems
- New EW systems to be supported

The requirement should be specified in all particulars, as defined in Chapter Three (Figure 3-1, Sample ADP Requirements Specification Form).

VALIDATE NEW REQUIREMENT

Following definition, a new requirement requires validation by the ISS community. Generally, this requires a series of interviews with representatives of each ISS to assure that the new requirement is completely and consistently defined. This survey should review the general nature of the requirement, its overall size and general technical thrust, expected frequency of usage, and possibly its relation to existing requirements. The result of this review is a composite requirement specification, as defined in Chapter Four. This specification is then presented to cognizant management for validation.

HARDWARE AND SOFTWARE IMPACT

After a new requirement has been defined and validated, the definition must be expressed in terms of ADP hardware and software resources. This means that the requirement must be translated into system usage terms such as:

- Size, form, and frequency of system inputs, e.g., data, analysis routines, and assorted queries
- Expected frequency, method of submission, and required turnaround for runs
- Special requirements for computation or peripheral devices
- Additional new code required to install the new requirement and provide for anticipated growth
- Expected usage of existing resources and any modification or extension required for such usage

SYSTEM ARCHITECTURE CHANGES

At this point, it is necessary to review the existing system architecture to see whether the new requirement implies a growth of capacity, reconfiguration, or change in operating philosophy. Unless the impact is self-evident, the best procedure is to introduce the new requirement as a tentative increment to the existing system workload and block diagram schematic. The impact of these increments can then be traced by using the cost-benefit methodology described in the following section.

COST-BENEFIT ANALYSIS

Updating the cost-benefit analysis consists of two major tasks. The first task is to estimate the incremental system costs resulting from the new requirement. These costs will appear as growth factors in either or both of the following basic categories:

- Investment for new hardware and development of new software
- Operation and maintenance (primarily new staffing) to satisfy the new requirement

As before, system benefits are viewed in terms of system performance: how well a configuration serves the expected workload. In practice this means repeating the system simulation as described in Appendix E. The basic steps are as follows:

- Define the incremental job stream resulting from the new requirement
- Add the incremental job stream to the baseline job stream
- Define architecture variants of the original schematic
- Present the augmented job stream to the original architecture and to the tentatively defined variants
- Compute system performance for baseline and augmented workloads for baseline and augmented architecture

The last step is of particular interest, since the new workload may interfere with the baseline service.

MANAGEMENT DECISION

The results of this analysis are then presented to the appropriate management authority for an implementation decision. If the decision is made to implement the requirement, the augmented workload and resulting new architecture (if any) become the baseline for further analyses.

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8